THE

JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

VOL. VII. Nº 150—10th YEAR.] LONDON, JULY 20, 1858. [Subscription 15s. in Advance / per Ann. 18s Credit.] DOUBLE No. Price 1s.

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Ratcliff Gas-Works, July 19, 1858.

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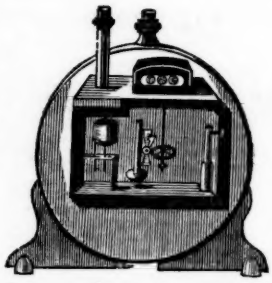

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is prepared to supply Gas and Water Companies with Apparatus and Appliances of every description, including Cast and Wrought Iron Goods, Coals, Fire-Bricks, Retorts, &c. &c.
Any communications addressed to him as above shall have prompt attention.

TAR and GAS-WATER WANTED.—Particulars to Messrs. HILLS and Co., Warsash, SOUTHAMPTON.

CROSLEY & CO.,

GAS-METER MANUFACTURERS,

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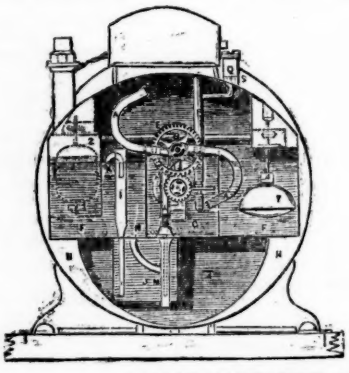

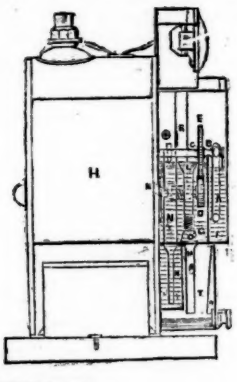

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PATENT STANDARD SELF-ADJUSTING AND COMPENSATING GAS-METERS,

By which the True Water-Line is constantly maintained, and accuracy of measurement at all times secured. SEVERAL THOUSANDS OF THEM HAVE BEEN FIXED, AND ARE NOW AT WORK, and numerous Testimonials from eminent Gas Engineers, expressive of their approbation of them, may be seen at the Manufacturers'.

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C. and Co. continue to manufacture ordinary WET METERS of the very best description, Mr. W. Crosley having been for many years the principal and confidential assistant of his relative, the late Mr. Samuel Crosley, of Cottage Lane, City Road, up to the time of his decease, in which capacity he communicated to W. C. the secret of the mixture of the metals which has rendered the Crosley Meter so durable and superior to all others, as is evidenced by a large number of them being still at work after having stood the test of nearly a quarter of a century's use.

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TO CORRESPONDENTS.

H. W. S., Seaham.—*The process has been abandoned at one of the large works, where the only trial we have heard of has been made.*

Dr. C., Edinburgh.—*The question of subways has engaged the attention of several able engineers. Mr. Newlands, the engineer of the Corporation of Liverpool, has reported on the subject, and the Metropolitan Board of Works recently invited a competition, but the result has not been satisfactory, and the whole question is for the present at rest except so far as it relates to new streets.*

NOTICES.

The subscription is 15s. per annum, if paid in advance during the month of January, or 18s. credit, in two sums of 9s. each, in July and January of each year. Post-Office orders must be made payable at the Charing-Cross Money-Order Office, to William H. Bennett, No. 42, Parliament Street, Westminster.

The next number will be published on Tuesday, Aug. 3, and the subsequent numbers on each successive alternate Tuesday.

Stamped copies, when forwarded by post, must be folded so as to expose the stamp; they are otherwise liable to the full postage charge for letters.

This JOURNAL has been duly registered at the General Post Office for transmission abroad.

All Communications to be addressed to the Editor, No. 42, Parliament Street, Westminster; and orders for Advertisements to the Publisher, Mr. W. B. King, No. 11, Bolt Court, Fleet Street.

THE JOURNAL OF GAS LIGHTING, WATER SUPPLY, & SANITARY IMPROVEMENT.

TUESDAY, JULY 20, 1858.

NOTES UPON PASSING EVENTS.

IT is curious to observe how, after many years of folly and deception, public opinion, in a free country, invariably rights itself. The struggle against error is, of course, a long and an arduous one; full at times of bitter disappointment, and always with more than its fair share of hope deferred. But in the end, truth is sure to prevail, if no extraneous influence be brought to support the fashionable errors of a day; and though many an advocate of right doctrines may wax faint during the struggle, though error may occasionally seem to be very long-lived, yet they who hold out to the end may console themselves for their past sacrifices by the success of the cause for which those sacrifices were made.

The moral of these remarks, it appears to us, is singularly pointed by the history of the sanitary movement which has taken place in England of late years. Begun, no doubt, with the best and most philanthropic intentions, that movement was soon adopted by a clique of trading politicians and jobbing literary adventurers, who saw in it the elements of a constitutional change in the government of the country, which would allow them to make places for themselves, and at the same time to increase the power of the Central Administration. This was, in fact, the burthen of the monotonous songs we have so often heard with respect to local abuses, local misgovernment, and the necessity for central guidance. The regret for the assumed loss "of the plenitude of manhood" possessed by our ancestors, meant nothing else, indeed, than the expression of the desire to retain place and pay at present; nor can the persevering efforts of the sanitary empirics to discredit the professors of recognized science be attributed to a better or purer motive. Fortunately for England, it has happened that the men who have succeeded in "riding the storm" they themselves had excited, were not able to retain the influence they had thus surprised; more fortunately still, these persons had compromised themselves to a set of theories, with respect to physical science as applied to engineering, which have signally failed in practice. And now, after some years of hesitation, and after very heavy pecuniary loss, the public appears to be arriving at the conviction that it had yielded itself to blind guides, or to guides to whom it would be charitable to impute blindness. The reaction is beginning. People ask themselves, and even Lord Ebury repeats the inquiry, whether much that has of late been done for the so-called improvement of our towns may not be itself a cause of the pressing and increasing evils under which we labour? The marked failure of recent legislative enactments passed by the so-called school of Sanitary Reformers, and of the works executed by the engineers it patronized, have alike tended to undeceive the nation as to the merits of that school, and to cause it to return to its former principles of self-government, and to its former professional guides. Truly, they who have always protested against the follies of the day must have cause to rejoice at the tardy recognition of their principles, even though their services be forgotten; for the world is so organized that results are adopted, but the labourers who have secured them are passed by with indifference when the struggle connected with those results is over.

In London itself, and in all that is connected with the administration of that vast province of houses, we thus see that slowly, but surely, the principles of Local Self-Government and the recommendations of really "eminent engineers" are now likely to prevail, instead of the impertinent interferences of the Palmerston and Hall clique, or of the follies of the Chadwickian "practical men." There is, indeed, every probability that the works designed by the engineers consulted by the various commissions or local authorities of the metropolis will shortly be commenced, notwithstanding the delays or the difficulties interposed by official obstructives. This is as it should be; but how serious has been the delay! and who can say what consequences it may entail? Perhaps, however, it is in vain to dwell upon the past in these matters; and so we content ourselves by congratulating the public on the fact that Lord J. Manners is disposed in the main to allow the local institutions of the metropolis to deal with their own concerns, as they judge best.

But we repeat here again, that though the state of the Thames be unquestionably such as to challenge the most serious attention of our rulers, the influences which have so injured it are at work in almost every other valley of the Empire. It would seem, indeed, that the object of our Sanitary Reformers has been of late limited to providing legislative facilities for the pollution of our streams by municipal bodies; for, be it observed, there has been developed, simultaneously with the system of great sewerage outfalls, a constantly-increasing interference with trade operations, of a nature to produce, on a smaller scale, any of the evils attached to that system. In none of the recent Local Government or Public Health Bills is there any efficient provision for the disinfection of sewerage before it is allowed to be poured into the natural watercourses. In none of the towns sewered by the officers of the late Board of Health have any efficient means of disinfection been applied; but, on the contrary, at Croydon, Uxbridge, Southampton, Stratford, Sandgate, Chelmsford, &c., the nuisance attending the discharge of the sewerage has either been so monstrous as to create epidemics, or to give rise to vexatious and costly law suits. Other towns will sooner or later find themselves in a similar position; and surely it was the duty of those who pretended "to guide" public opinion in these things, to take care that the removal of one nuisance should not create another of greater importance, and that the rights of individuals should not be sacrificed for the assumed

advantage of the public. The errors of the Sanitary Reformers have, indeed, been quite as much errors of omission as they have been of commission.

Yet the extraordinary character of the two last seasons would appear to place the latter class of errors in especial relief, to use a pictorial phrase. Some time since we called attention to the failures of the water supplies at Dover, in the south; at Rugby, in the centre; and now we observe from the local papers that the same remarks may be applied "*mutatis mutandis*" to Berwick-upon-Tweed and Alnwick, in the north. In both those towns the water supply is deficient, and great suffering and inconvenience has thus been entailed. Now, we are far from saying that private engineers do not make great blunders, and we willingly admit that when even private engineers attempt to carry out the "constant supply," for and under the direction of municipal bodies, they are nearly as sure to fail as the Engineers of the Board of Health have done. But this very risk of failure, even with the advantage of the services of eminent engineers, ought, we believe, to convince the public that it is a mistake to change the performance of a mere trading operation into a municipal duty. It is this social error which we hold to falsify the whole of the modern legislation on Sanitary matters; and it is to this error that we attribute the costly mistakes and the gross injustices we have been compelled to signalize in matters connected with Gas and Water Supply. Nor does the danger of the mistaken principle against which we thus protest stop here; for the ultimate consequence of its application in one marked instance, is always made the pretext of its extension to other cases, and at last individual liberty is annihilated by the tyranny of the whole body of the State. From evil good often, however, arises: and so we cannot say that we feel as much regret as we ought to do in reading the tale of the grievances of the Berwick and Alnwick Local Boards of Health. How they may relish the position of the "*corpore vili*" on which the "*experimentum*" is made, is, however, quite another part of speech. The inhabitants of Rugby may, perhaps, enlighten us upon their feelings with respect both to the failure of their boasted water supply and of the sewerage irrigation; for, from the Rugby papers, we observe that there is "a serious difficulty" between the Local Board of that town and Mr. Walker, the lessee, as to the disposal of the sewerage.

In a subsequent part of this JOURNAL will be found a notice of the present state of the Plumstead Water Company's affairs, which are sad enough; but we feel it important to notice here one fact connected with that experiment, of a nature so generally interesting as to justify a special reference to it. This fact consists in the utter destruction of the lead cisterns stated to prevail throughout the district. It is hinted that some influential members of the Local Board of Health of Woolwich (guided and controlled, of course, by the Central authorities) were themselves plumbers, and that so the Board undertook to supply the lead cisterns. Whatever were the motive, it is certain that the Board did supply those articles; and now that the water, deprived of its bicarbonate of lime by the boasted softening process, has destroyed the cisterns, the consumers naturally call upon the local authorities to repair the damage. This should be a warning to those who admire "laboratory" experiments not to risk public money in the application of scientific theories, however specious or captivating they may appear.

We have also inserted a note upon the Artesian Well at Naples, which may be of interest to Hydraulic Engineers and to Geologists. We hear also that the Kent Water-Works Company have met with some very remarkable results in sinking a third well in their grounds, near Deptford. It is said even that they obtain between three and four million gallons of water per day from these sources; but we confess that we are sceptical as to the amount, and will make further inquiries in the matter. It is curious, however, to observe that this Company is erecting for its own purposes the engine made for the Dartford Water-Works, and sold by public auction when the Dartford Local Board of Health fell into difficulties. *Sic transit gloria Chadwickii!*

The country papers also tell us that at Lincoln, and in the island of Axholme, the hot weather is beginning to produce the usual intermittent fevers of those districts. What a pity it is that more correct opinions upon sanitary matters should not prevail in these marshy districts; and how strange it is that precisely in the districts where it is most essential to observe the laws of Hygiene, there the most profound ignorance of, or the most culpable in difference to, those laws should prevail! But so it is; and even the banks of the Amstel bear witness, nasally, of the existence of the law. Truly, common sense seems to be a rare virtue; and it certainly does not abound amongst the dwellers in lands intersected by stagnant ditches, receiving all the filth of the dwellers on their banks!

Nor does common sense appear even to burthen the officials who draw up the Registrar-General's Reports, or those who are charged with the duties of our Speaker's Office. Our old friend the Registrar-General has, for instance, of late endeavoured to frighten the old ladies of London by the sad accounts of the mortality of that town; but, when he called attention to the fact that the mortality has lately been rather in excess of the usual average of the season, he forgot to mention that the temperature has also of late been notably in excess of the average temperature, and that the horizontal movement of the air has been in a very abnormal state. It is absurd, then, to suppose that when such variations exist in the meteorological conditions of the most densely peopled city in the world, the ordinary laws of mortality should prevail; and we therefore hold that the Registrar-General has neglected to draw the inferences he ought to have done from the circumstances before him, or which he would have drawn had he listened rather to the dictates of common sense than to those of a preconceived theory. As to the Speaker's Office and its errors, we allude again to the gross blunders it allows to appear in the numbers of the divisions. As the *Parliamentary Remembrancer* justly remarked, it is disgraceful that the Tellers, or the Clerks of the House of Commons cannot even add up correctly the votes given on important occasions. There actually was an error of nineteen in one recent case! Surely, in these days of competitive examination, the House of Commons ought to be exempt from such gross errors in the most elementary branch of arithmetic.

The Government measure for assisting the Metropolitan Board is now before the public; and, on the whole, it must be considered to be a valuable step towards the solution of the difficulties of the vexed question of the improvement of the Thames. It provides, at least, the ways and means for a great part of the outlay; and though the objectionable power of the Government to interfere be still partially retained, it is hard to believe that when the State is compelled to lend its credit, it can entirely give up all control over the outlay. So long as reasonable men are in office, no inconvenience may result from this control; but by sad experience we know the danger it may involve, and therefore it is that we still regard the conduct of the Board of Works towards the Metropolitan Board with a certain amount of suspicion. We will return to the consideration of the whole of this subject, especially as we have not had the time to examine the somewhat angry reply of the Government Referees.

THE LAME CONCLUSION OF THE GAS INQUIRY.

THE parliamentary inquiry into the alleged misdeeds of the metropolitan gas companies has come to an untimely end. It was evident, from the course of proceedings reported in our last number, that there was little chance of the evidence being completed during the present session, and so the committee threw up the matter as a job they were tired of, and resolved to report that they could not get through with it, leaving the House to determine whether the committee should be re-appointed next year. That resolution was agreed to as soon as the committee reassembled on the 6th inst., but as all the parties were present it was thought best to conclude the evidence of the witness who was under examination when the adjournment took place on the former day.

The witness in the hands of the committee was Mr. Slee, a mustard manufacturer, of Bermondsey, who, after detailing various annoyances, sufferings, and wrongs he fancied he had borne from the Surrey Consumers' Company since the districting of South London, undertook to enlighten the committee on the subject of the cost of gas. Heedless of the adage, "*Ne sutor ultra crepidam*," he quitted, once upon a time, his pungent seasoning to try his hand at making gas, and the committee sat for several hours gravely listening to particulars of the operation and to the conclusions he arrived at. He related how he took a pound of Newcastle coal from his coal cellar; that he put it into an experimental retort, which he introduced into the kitchen fire; and how, after a short time, smoke, vapour, and gas issued forth, which he collected and measured; and found that he thus obtained four cubic feet of gas and half a pound of coke. From this im-

portant experiment he calculated, in defiance of Cocker, that each ton of coal will yield 9900 feet of gas; and, reckoning the price of coals at 15s. per ton, he came to the conclusions that the cost price of gas is 2s. 3d. per 1000 feet, and that gas companies who charge 4s. 6d. obtain a gross profit of £1. 17s. 6d. on each ton of coal carbonized. In this estimate of the cost price of gas he made no allowance for leakage, nor was the illuminating power taken into consideration; so that, if the average waste were allowed for and gas of good quality produced, the cost of manufacture, as deduced from this grand experiment, would considerably exceed that stated by the gas companies. If it be possible to add to the folly and absurdity of adducing such evidence as a guide to the decision of a great practical question, the climax was capped by the glaring blunder of nearly 1000 in the multiplication of the number of pounds in a ton by the figure 4; and, when the error was pointed out to the witness, he treated it as a trifling mistake, that would not affect the correctness of his calculations.

It was fortunate for the preservation of the dignity of parliamentary inquiries that the committee did not sit another day after hearing such evidence, or they might have been overwhelmed by a shoal of experimental philosophers offering to give similar testimony. Tom, Dick, and Harry, now at home for the holidays, were ready with no less valuable and important evidence, and with deductions still more damaging to the gas companies. They would have deposed that they took some coal out of papa's coal scuttle, that they put it into the bowl of a tobacco pipe, covered the top with clay, thrust it between the bars of the kitchen range, and that in a short time out came a jet of smoke, which burnt brilliantly for several minutes; and that this beautiful light cost them nothing at all. They were further prepared from these data to prove that the profits of gas companies must be enormous, and that papa's drawing-room ought to be lighted the year round for sixpence. All this important evidence has been stifled by the sudden prorogation of the committee, who could not otherwise in fairness have refused to receive it with as much serious attention as they bestowed on the trick of the mustard-making witness with his pound of coal, performed twelve years ago. It was observed by a wit in the committee-room, that though the evidence of this witness had none of the pungency of the article he manufactures, it was quite as much to be sneezed at.

It is to be hoped that the Emperor of the French, and the colonels of his army, will not take offence at the prominence given to this experiment of making gas with a pound of coal, by fancying it is intended as a burlesque of the experiments he instituted three years ago at St. Cloud. Those experiments were, however, conducted on a larger scale, with many tons of coal, in a gas-work expressly constructed for the purpose; and they were carried on for several days under the superintendence of four distinguished members of the Institute of France. But even in that case the results proved the fallacy of conclusions drawn from isolated experiments, on however large a scale they may be conducted. The French Academicians, more successful than Mr. Slee, contrived to get 74 per cent. of coke out of their coal; and whilst he estimates the cost of gas at 2s. 3d. per 1000 feet, they arrived at the conclusion that it might be made for 4½d. They managed, indeed, so cleverly as to obtain more matter, weight for weight, out of the retorts than was put into them. These numerous large experiments of the French Academicians would have told much more strongly against the gas companies than the solitary diminutive product from the alembic of the experimental philosopher of Southwark; but the "very valuable results" of his great "laboratory experiment," as it was facetiously called, were considered more important than all the preceding experiments and practical results obtained during the course of twelve years. Had not the minds of those who were engaged in getting up the South London case been so exclusively absorbed by this great coal trick, they might, instead of backing the calculations of the Southwark philosopher by the evidence of Mr. Croll, and thus arriving at a cost price of 2s. 3d. per 1000 feet, have taken the naked fact that he contracted to supply the City of London with gas for 1s. 4½d. They need not have mentioned that he afterwards claimed compensation for the losses sustained in fulfilling his contract; nor need they have stated that, notwithstanding the company were so cheaply supplied with gas, they have not for several years past paid more than 8 per cent. The South Londoners might, perhaps, have been afraid of the latter fact coming out on cross-examination, and that would have given a heavy blow to the calculations of £22. 10s. per cent. profit, with a cost price of 2s. 3d. per 1000. It must be admitted, indeed, that it was more in accordance with the imaginary grievances and with the anticipated dangers which have given rise to the gas movement in the metropolis to rest the case on the imagination of Dr. Challice and on the puerile pastime of Mr. Slee, than to attempt to base it on facts and experience.

The delegates from the rest of the metropolitan districts seemed to be heartily ashamed of the evidence about the pound-of-coal experiment, and even the chairman of their meetings could "stand it no longer." In making his exit from the committee-room he encountered Dr. Challice, and those who witnessed the meeting of the learned doctors, report that the Ph. D. gave utterance to his feelings in language not fitted for ears polite. The learned Doctor, who "knows something about gas," ought to be tenderly considerate to those less gifted than himself. It is a too common failing with very clever people that they make not sufficient allowance for want of cleverness in others; and though the case might doubtless have presented a very different aspect had Dr. Bachhoffner been placed in the van of the battle, he should bear in mind that it is not in all mortals to command success. Although he, with his wonderful powers, and with the vast resources of the large establishment that he manages so ably, daily conveys numbers of passengers to Paris and back for one shilling in less than an hour, it would be unreasonable to expect the South-Eastern Railway Company, managed by men of ordinary capacities, and with ordinary resources, to do the same. In like manner, it is unreasonable in him to expect that an ordinary medical officer of health, or a mustard manufacturer of Bermondsey, should attain his standard of excellence in giving evidence. It is even possible that when subjected to cross-examination before a parliamentary committee, many of his own seemingly substantial grievances might turn out to be but "the baseless fabrics of a vision," having less reality about them than the enchanting trip "To Paris and back for one shilling. No passport required."

The majority of the committee seem also to have been ashamed of the evidence they had allowed to be given, and a motion of Sir John Shelley's to report it to the House was rejected. It would, under ordinary circumstances, have been unfair to have placed on the journals of the House of Commons, without comment, the testimony of witnesses called to substantiate charges until the rebutting evidence was also given. In this case, however, the gas companies would have had little reason to complain, for most of the charges adduced were refuted by the witnesses who made them.

It appears from the report made to the House that on the last day of sitting there were four divisions in the committee, in each of which the nominees of the parishes adhered together, but failed to carry with them a single independent member. The evidence against the gas companies has produced an effect the opposite of that intended; and Sir John Shelley, not being able, even in the presence of the public, to restrain the expression of his annoyance on finding all the independent members against him, upbraided his dissentient colleagues, in a petulant tone, with having got the majority and refusing to let his friends go on. The parish nominees mustered in full force at the last sitting: four only of those nominated by the gas companies were present, and but three of those nominated by the Government, including the chairman, yet in every division the parochial nominees were left in a minority. The report agreed to by the committee is the shortest of parliamentary publications, and is all contained in the following words:—

"That, in consequence of the lateness of the session, and of the impossibility of concluding the inquiry during this year, your committee have determined not to hear further evidence at present, and beg to recommend to the House their reappointment at the commencement of the next session."

Thus has ended—for this year at least, if not for ever—the valorous onslaught of the parochial delegates against the gas companies of the metropolis. If it may be permitted to compare small things with great, this terrible charge by the united parishes may be likened to Southey's description of the charge of the Imperial Guard at Waterloo:—

> "In one large torrent, broad and strong,
> The advancing onset rolled along;
> Forth harbingered by fierce acclaim,
> That from the midst of *smoke and flame*,
> Pealed wildly the *Imperial* name."

The Imperial company may, it is true, have given some cause for being thus singled out for attack, but "the terrors of the

charging host" were lost upon them as well as on the "British hearts" at Waterloo. The flame which animated the charge is extinguished, and it has for the present ended in smoke.

THE PRESENT STATE OF THE PLUMSTEAD PURE WATER COMPANY.

A Report has lately been issued by the Committee appointed by the Shareholders of the Plumstead, &c., Pure Water Company (Limited), to investigate the state of the affairs of that undertaking. This Report is of the very saddest and most disheartening character, to those, at least, who may be interested in the venture; and, under ordinary circumstances, we should have felt it to be our duty to allow the subject to be "quietly inurned;" for, on the principle that "*de mortuis nihil nisi bonum*," it is usually advisable to say as little as needs be on the failures of private enterprise. But this unlucky Plumstead Pure Water Company has had the misfortune to have been patronized, and held up for imitation, by the official guides of the municipalities about to undertake the distribution of water; and its proceedings have even been referred to, by the delegates of those official guides, in foreign lands; so that it really becomes a matter of public importance to inquire, even more fully than the Committee of the Shareholders has done, into the causes of the bad success of the operation which has thus been held up for our imitation. We do not possess any private sources of information on the subject, however; and the remarks we are about to make are entirely based on the statement put forward by the representatives of the Company.

It appears, then, from this *ex parte* statement, that the Plumstead Company was instituted in 1852 for the purpose "of supplying continuously good water, at a cheap but remumerative price," in a district containing (in 1851) about 45,588 inhabitants and 7593 houses. Since then the Company has expended, or become liable to, a capital sum of not less than £58,395 in round numbers. The actual working results of the Company seem to have been that the total number of houses now supplied is about 2967; and that "the present position of the Company (so far as regards profit) is clearly this—that if the works had not cost a single farthing, it would not be profitable to carry them on." These are the very words of the report; and be it observed that therein they are italicised, as though it were intended to draw especial attention to them. It is no light matter thus to waste £50,000 of the public money, and therefore it is that some serious investigation of the subject is required, even if no other motive existed for so doing. What were the causes of this disastrous failure? what practical lessons does it afford?

Now, it would appear that, if the works of the Plumstead Pure Water Company had been conscientiously carried into effect, the capital they are supposed to represent is not much in excess of that which ought to have been employed. An outlay of from £1 to £1. 10s. per head of the population supplied is the usual average of water-works undertakings; and in the case of the Plumstead Company the small excess beyond the lower sum thus indicated may be easily explained by the additional cost of the machinery and plant required for the application of the much-vaunted softening process. We do not, therefore, think that, *primâ facie*, the capital account can be said to be exorbitant; though, certainly, many of the items seem to be open to grave objection. But when we come to examine the working accounts, some very serious considerations force themselves on our notice.

In the outset we naturally ask ourselves how it happens that a Company, which professes to supply a water perfectly pure and soft, cannot command a preference over a rival Company in its own district which supplies a water stated to be very inferior in quality? There is, in fact, at Plumstead and Woolwich, a very strong opposition between the Kent and the Plumstead Water Companies, the former of which supplies the filtered waters of the Ravensbourne, and the latter the purified well waters of the Chalk. Yet it is manifest that the new Company cannot hold its ground before its ancient rival; and this is the more singular, because, even from the Report of the Committee, it appears that the Kent Water Company charge both a higher price per house and per 1000 gallons than the Plumstead Company do. It is absurd to suppose that the public would continue thus to pay a higher price for a lesser quantity of an inferior article; and the inference therefore is, that there must be some deception, or some mistake, as to the relative supplies, or qualities of supply, by the two companies. We believe ourselves that there is, on the part of the friends of the Plumstead Company, a great mistake as to the commercial superiority of its supply; and we also fear that the manner in which it has attempted "continuously" to yield that supply has had much to do with the ruin of the concern. In this instance, as in many others, the interference of the General and Local Boards of Health has been fatal to the success of the Water-Works speculation, *per se;* and we are sure that much of the fearful waste of water which prevails at Woolwich is to be attributed to the bad engineering arrangements of the sewerage works, executed under the control and guidance of the Central Board. A supply of water at the rate of 200 gallons per house per day is manifestly in excess of anything which ought to exist; and it is in itself a proof that a culpable waste exists somewhere. Moreover, it is to be observed that even the limit of 200 gallons per house per day is only attained by restraining the supply at certain seasons of the year; so that, really, the said supply is not *continuous*.

It may be on account of the forced limit thus placed upon the supply that less than one-half of the houses of the district receive water from the Plumstead Water Company. But, be this as it may, it certainly appears that the total number of houses in its district was, in 1857, no less than 7560, whilst only 2967 houses received water from its mains; and, be it again observed, the annual revenue per house received by the Plumstead Company was only 14s. 8½d., whilst that received by the Kent Company was £1. 10s., and the prices per 1000 gallons delivered were respectively 2½d. and 8¾d. We confess that these figures, extracted from the Committee's Report, stagger us completely.

At any rate, this fact appears to be proved, that the working expenses of the Plumstead Company are about 6d. per house more than those of the Kent Company, even upon the showing of those who are interested in making out the best possible tale for the former. The question then naturally arises, Why should this be the case? Is the boasted softening process responsible for any of the additional cost? and, if so, "does that game pay for the candle?" We think, candidly, that it does not, and that the committee have erred in not at once recommending the cessation of that costly and, as it proves, that useless experiment. The cost of the lime used for softening the water has alone amounted to 6 per cent. of the gross working expenses; and the accounts do not enable us to say what proportion of the wages and other outlays ought to be charged to the same head. No doubt it would be fair to estimate them at 12 per cent. on the working expenses; and observe, that this serious increase is incurred for the sake of obtaining a water which, even when sold at a rate per 1000 gallons two-thirds less than that of the water sold by the rival Company (always reasoning upon the statements put forth by the Committee of the Plumstead Company), cannot ensure its being taken by the majority of the public. Either the dwellers in Plumstead, &c., must be remarkably stupid, or the tale thus put forth must be false.

Practically, we believe that the result of this Plumstead Pure Water Company will be that the softening process will be abandoned (notwithstanding the silence of the Committee on the subject), even if the Company should continue to exist. The latter contingency, it appears, can only occur on the condition of a bold outlay on the part of the shareholders. Will they consent to such an increase of venture in a concern which offers very little prospect of success? We suspect that they will not, and that this attempt to introduce the "softening" process will pass to the limbo of the "self-cleansing sewers," the pot-piped "gathering grounds," and the "sewerage irrigation" of the Chadwickian School. Who shall tell the mischief and the ruin that school has entailed?

It may be important to add that the Plumstead Company, having a nominal share capital of £45,335, and debts amounting to £13,500, is obliged to seek the means of raising a further sum of £7000 to justify its Directors in hoping for any increase of revenue. Who would, we seriously inquire, advance money on such a security as this Company can offer? The new capital would be "precipitated," in all probability, even more effectually than the lime in solution in the Company's waters now is. It may be that local shareholders, knowing more of the prospects of the Company and of its past management (or mismanagement) than we can do, may judge more favourably of its future; but this, at least, seems to be proved by the results of the

working of the "softening" process, viz., that it can neither command a sufficient number of customers, or a sufficient price to ensure an adequate return for the outlay it requires.

If we might be allowed to give a little friendly counsel to the Plumstead Company, it certainly would be to advise them to come to some arrangement with the Kent Company. The public is, we fear, ungrateful; and it will not impose on itself any sacrifice to enable even a Pure Water Company to support a competition of a ruinous character. In these matters the first loss is usually the least; and we fear that a continuance of the struggle will only involve injury to both parties, without any eventual benefit even to the public.

Circular to Gas Companies.

The parliamentary inquiry into the supply of gas in the metropolis has, for the present at least, come to a premature end; and if the rapid advance which is taking place in the shares of many of the gas companies interested, is any indication of the feeling entertained by the holders, they are not dissatisfied with the result. They, indeed, have substantial reason to congratulate themselves on the eagerness of the South London grumblers to be first heard; and we apprehend few will be cruel enough to refuse to condole with Dr. Bachhoffner and Mr. Hughes, and the other magnates of the northern districts, at the disappointment to which they are subjected in being compelled to retain their grievances pent up within their own breasts for some months longer. Bermondsey is entitled to all the honours of the campaign just concluded, and Marylebone is apparently not inclined to dispute the laurels won by her southern ally. We have, however, obtained an insight into the nature of the alleged grievances, and though we are far from saying that none absolutely exist, yet we are now warranted in expressing the deliberate opinion that the leaders of the movement have completely mistaken their nature and their remedy. "*Aide toi et le ciel t'aidera*" is a parliamentary as well as a political maxim, and if the metropolitan public really believe that the gas companies treat them illiberally, or make too high a charge for the article they supply, let them subscribe their money and try the experiment for themselves. The issue as to whether 4s., or 4s. 6d., or 5s. per 1000 feet is a remunerating price for gas will then be fairly raised; but no parliamentary committee will ever venture to interfere with the rights of property, or compel a trading company to sell the article in which it deals at such prices as may be fixed by the consumer, when its capital has been subscribed and invested in accordance with the powers granted to it by the Legislature. If the price demanded should be proved to be unreasonably high, and parties present themselves who are able and willing to supply it at a lower rate, or are satisfied with a smaller profit, Parliament will probably grant them competing powers; but any attempt to coerce an established company against its will, in the manner suggested by the promoters of the present movement, is wholly unprecedented and obviously unconstitutional. Such being the case, it becomes worth the consideration of the gas companies themselves whether it might not be politic on their part to take the initiative next session, and prosecute one or more bills framed in a liberal spirit, and affording all reasonable protection to the consumers against any abuse of the existing monopoly. A general bill will scarcely suffice, as some of the companies are in a different position to others, inasmuch as they have invested their undivided profits in extending their works, which sums will have to be capitalized, or converted into debentures at a low rate of interest, as in the case of the Imperial Company in 1854. It is not impossible that the Government may so extend the Weights and Measures Act as to embrace the testing of gas-meters throughout the country, and thus relieve the companies from the responsibility attending that branch of the late inquiry; but, in the absence of any definite intimation of the intentions of the Government in this respect, it would not be prudent to leave the matter unprovided for in any measures the companies may propose.

Acting upon the principles laid down in the judgment delivered in the case of *Broadbent v. the Imperial Gas Company*, Vice-Chancellor Wood has interfered by granting an injunction in another nuisance case, a full report of which will be found elsewhere in our present issue. In this last, the principles upon which the court acted in the Imperial case are further extended, and it is difficult to conceive how any trade deemed noxious can be carried on so long as such an exposition of the law prevails. There is scarcely a trade or manufacture which is not now at the mercy of any litigious neighbour, and hence the great interest felt in the issue of the appeal pending in the House of Lords in the Broadbent case.

We extract from a local paper an account of a serious explosion at the Cardiff Gas-Works, by which a recently erected gasholder of large dimensions has been totally destroyed. By some unexplained means a light was communicated to an explosive mixture of gas and atmospheric air with which it was filled, affording thereby another proof of the danger of allowing careless and ignorant workmen to intermeddle so long as any liability to explosion exists. The gasholder is a new one, but is stated to have been "under repair," and the repairs embraced the strengthening of the internal framing; from which we infer that some defect in the original design or construction had manifested itself which it was deemed necessary to rectify. The designing of gasholders of the gigantic dimensions employed of late years, involves an acquaintance of the highest order with the principles of construction and the strength of materials; and, from the numerous failures which have come to our knowledge, we fear it is too often made a "rule-of-thumb" operation by contractors whose knowledge of the theory of their trade is very limited.

An intelligible and, at the same time, a very creditable balance-sheet of the operations of the Worksop Gas Company, for the year ending June 1st last, will be found in another column, and we insert it all the more readily because we some time since felt it to be our duty to criticize the proceedings of this company somewhat severely. It will be seen that they have voluntarily reduced the price of gas from 5s. 10d.—which they are allowed by their bill to charge—to 5s. per 1000 feet, and this while the maximum rate of dividend is a long way from being attained. As the balance-sheet gives the quantity of coal used and gas produced, the working charges are easily apportioned under their proper heads.

Communicated Articles.

ACCOUNT OF A BORING LATELY EXECUTED AT NAPLES.

In the "*Comptes Rendus de l'Académie des Sciences*" of May 24, 1858, is inserted a description of a very curious and interesting artesian boring, lately executed in the volcanic region of the south of Italy. This account may, perhaps, interest engineers connected with our own possessions in the Mediterranean, and, therefore, a translation of it is subjoined.

The boring lately executed at Naples, at the King's Palace, was begun by MM. Degousée and Laurent in 1851. It was commenced under the impression that a depth of 820 feet would be sufficient; but, in 1854, the boring had reached a distance of 1525 feet from the surface, after having been frequently interrupted by the expiration of successive contracts. Deducting the loss of time occasioned by these administrative delays, and in spite of the difficulties attending these operations in an unknown geological formation, it thus appears that the above-mentioned depth of 1525 feet was attained in less than two years of actual labour, by day and by night.

The terrace of the palace, forming the garden in which the boring is placed, is situated at 66 feet above the level of the sea, and the axis of the boring is placed at about 507 feet from the shore-line. Below the vegetable soil and the made ground, the boring-tool traversed, 1, a bed of solid volcanic tuffa, about 282 feet thick; and then, 2, a formation consisting of alternate layers of sand, pumice mixed with ashes, sandy clays, and trachytic pebbles, of a thickness of about 400 feet. The base of the volcanic deposits of the Bay of Naples at this spot would, therefore, appear to be situated at a depth of 682 feet from the surface, or 616 feet below the level of the sea. 3. The sub-appenine formation which underlies this volcanic deposit is composed of blue marl, more or less compact and sandy, with marine shells; of fine sands, enclosing rolled pebbles of sandstone and marine shells; and then of compact micaceous blue marl. The base of this formation is situated at a depth of about 1000 feet below the level of the sea, and its thickness is about 380 feet. The sands it contains have a thickness of 84 feet, and they yield a spring of water rising to the level of nearly 28 feet above the mean level of the sea. 4. Below this formation the boring was carried into the *Macigno*, which is characterized by the presence of fossil remains of sea-weeds, and by the absence of fossil shells. The different beds of the *Macigno* are composed of friable sandstones, of sands, and of clayey marls, which extend to a depth of 1460 feet below the level of the terrace, or 1394 feet below the level of the sea. In the sands, a second spring, of greater ascentional power than the first, was met with,

which rose to a height of about 34 feet 5 inches above the sea-level.

The second spring rose in a central tube, fixed in the boring, whilst the first spring was retained in the annular space comprised between that tube and an outer one of larger diameter. The level of this first spring remained constant, but the level of the interior column underwent frequent oscillations. A hole was, therefore, bored, horizontally, through both columns, at the height of 26 feet 8 inches above the level of the sea, for the purpose of drawing off the water at that point. But the workmen had hardly pierced the outer tube, the drill being still in the hole, when the water was shot out with an unusual noise through the hole, and with it such a quantity of carbonic acid gas was disengaged, that the workmen could with difficulty be dragged out of the well. From the top of the external tubes, placed at about 42 feet 7 inches above the sea, and over the whole of the open space between the two tubes, the water poured forth with great rapidity; but in falling again to the bottom of the boring, it was absorbed by the permeable strata which cover the volcanic tuffa, and thus escaped into the sea: the level of the water in the tube was only raised about 9 feet. The quantity of water discharged appeared progressively to increase, though with marked intermittences, after each of which great quantities of carbonic acid gas were disengaged; and as this gas remained stagnant at the bottom of the excavation, at 20 feet deep, it rendered the working very difficult.

From what has been above said, it was inferred with some probability that a considerable volume of water might be obtained if the water of the two springs contained in the outer and the inner tubes were removed with great rapidity. The King, who (according to the Imperial Academy) interests himself in all useful works, came to visit this boring on the 21st of September last; and, after having discussed with a special commission all the questions connected with the physical and geological conditions of the operation, he ordered the construction of a subterranean canal which might allow the waters thus obtained to be distributed in a part of the town. This canal was finished by the end of December; and some experiments, made in the course of January last, showed that the volume of the water flowing over, at the height of 26 feet 3 inches above the sea, varied between 74 and 102 gallons per minute. The temperature of the water was invariably 68° Farenheit.

Subsequently, on the 29th of January, the tubes were cut off at the level of 25 feet 7 inches above the sea, when the quantity of sand and water which flowed over rose to 220 gallons per minute. It increased progressively until the 14th of March, when a further gauging showed that the boring yielded about 286 gallons; and, at the present day, this quantity is further increased to about 310 gallons per minute.

On the reading of this notice, M. St. Claire Deville communicated to the Academy the following extract of a letter addressed to him from Naples by M. Guiscardi, in which the latter gentleman stated "that he had examined the gas disengaged from the water of the artesian well in the King's garden at Naples. The analysis was made 26th October, 1857, at ten o'clock in the morning; the temperature of the air being 67° Fahr., and that of the gas 68° Fahr. The gas is a mixture of atmospheric air and of carbonic acid gas; and the result of three experiments was that the latter was present in the proportions of 43·4, 41·0, and 42·3 per cent."

Register of New Patents.

11.—Edmond Thomas Tillam, steward, of St. Mary's Hospital, Paddington, in the co. of Middlesex, for "*Improvements in apparatus for ventilating buildings.*" Provisional protection only obtained. Dated Jan. 4, 1858.

This invention has for its object improvements in apparatus for ventilating buildings. For this purpose, where a gas-burner or a gas-stove is employed in order to carry off noxious and deleterious vapours, an outlet-pipe or passage is used at or near the upper part of the room or building to be ventilated. Into the outlet-pipe or passage the heated product of each gas-burner is conducted by means of an inverted conical passage placed over the burner, and connected above to the outlet-passage or pipe, in order to ensure a free current from the room or building outwards. Through the outlet-passage or pipe, steam is conducted by a suitable pipe into that passage near to its outer end, and such steam is generated by the heat of one or more of the gas-burners, or by the heat of a gas-stove, there being a suitable vessel containing water applied to such gas-burner or gas-stove, so as to generate steam sufficiently under pressure to cause it to pass in a jet or jets when it comes to the outlet-pipe or passage.

32.—Samuel Lees, of Salford, in the co. of Lancaster, manufacturing chemist, for "*Improvements in the manufacture of mineral oil.*" Patent dated Jan. 8, 1858.

This invention consists in distilling or abstracting the oil contained in coal, cannel, schists, or other mineral bituminous substances, by combining those substances with asphaltum or pitch, such asphaltum being the residue obtained in the distillation of tar produced in the manufacture of gas for illumination, or any other asphaltum or pitch obtained from the distillation of bituminous tars, and by the application, as hereinafter described, of heat, which dissolves the asphaltum or pitch, and causes the mineral bituminous substances to dissolve and give off their oil; this oil then combines with the dissolved asphaltum or pitch, and is separated therefrom in the form of vapour by the continued application of heat, which may be used at a high temperature.

The mode of operation is as follows:—The mineral bituminous substances and the asphaltum or pitch are first broken into pieces of any convenient size, and, by preference, equal quantities of each, by weight, are put into the still, the lid being removed to facilitate the charging. When the still is charged nearly full, the lid is put on, and fastened by bolts or otherwise; the joint of the lid must then be luted with cement or other suitable material in the usual manner; the remainder of the charge is then put into the still through the man-holes, and, when the entire charge is in the still, the man-hole lids are also secured and luted. In charging the still, the patentee prefers to place the mineral bituminous substances above the asphaltum or pitch.

The fire is then lighted on the grate bars, and the heat may be rapidly raised until it dissolves the asphaltum or pitch; the dissolved asphaltum or pitch, acting on the mineral bituminous substances in the still, liberates the oil in the said mineral bituminous substances and combines therewith; and the dissolved asphaltum or pitch, with the oil, gradually rise in the still, while the earthy portions of the mineral bituminous substances descend. When the mineral bituminous substances have been thus dissolved, it is desirable to maintain the heat in the still at a high temperature, in order that the oil combined with the asphaltum or pitch may be given off in the form of vapour; and this vapour, escaping through the worm-pipe, passes through the worm, and becomes condensed in its passage through the worm, which is kept cool by the water in a tank.

The mineral oil thus obtained may be purified by any of the old and well-known processes.

The residue arising from the distillation, when removed from the still, may be used as fuel, as it is a pure solid coke, which is a valuable result obtained by the use of this process as herein described.

The claim is for the mode of treating and dissolving mineral bituminous substances by the use of asphaltum or pitch, and the application of heat as described, and thereby abstracting the oil contained in such mineral bituminous substances.

38.—William Walker, of Liverpool, agent for Robert Brown, of the firm of A. and R. Brown, of Liverpool, plumbers and brass-founders, for "*Improvements in water-closets, part of which are applicable to pumps.*" Provisional protection only obtained. Dated Jan. 9, 1858.

This invention is mainly applicable to the class of water-closets known as marine or ships' water-closets, and consists in so forming the closet-pan that the discharge-orifice at the bottom thereof may be formed in an oblique or sideways direction. The rear of this discharge-orifice is provided with a slide-valve which works in an oblique direction, the slide of which is of a tapered or wedge-shaped form, and slides upon two pieces of metal, which are backed up with india-rubber, or other suitable elastic or semi-elastic material, which is held in grooves formed in the valve-seat. The valve-rod works through a suitable stuffing-box on the end of the valve-box. Immediately below the closet-pan, and connected therewith, is a small enclosed chamber or vessel, the inner side of the bottom being of a semi-circular form, and having jointed to the inner side of the top thereof a swinging valve-frame fitted with a valve-clapper opening backwards. This swinging valve extends across the chamber from side to side, and is also in close contact with the curved bottom. The discharge-opening of this pendulous valve-chamber is formed at the rear of the top, and is protected by an outlet-valve. The water being supplied to the closet-pan by any of the ordinary methods, is discharged on opening the wedge-shaped slide-valve on the throat of the pan by the action of the swinging valve, which has a pendulous motion communicated to it through a lever connected to its axis.

41.—William Parsons and James Attree, both of Brighton, Sussex, Esqs., for "*An improvement in the measuring of water and other liquids, and an improved water and liquid meter.*" Provisional protection only obtained. Dated Jan. 9, 1858.

This invention consists of a meter constructed and acting in manner following:—The pipe, cock, or inlet into the meter is divided into parts, say four; the way through one part only leads into the measuring apparatus inside the meter, while the way through the remaining three parts goes through the meter without entering the measuring apparatus. By knowing how many divisions there are in the inlet, in the present case four, one only leading into the measuring apparatus; then multiply the quantity shown by the indicator connecting to the measuring apparatus, in this instance by four, and you have the measure of the whole quantity delivered from the supply-pipe. The fourth, or other fractional part, as the case may be, of the liquid, enters a cistern inside the meter case, rises therein, and flows out of a pipe or series of pipes at the top thereof into a compound tilting basin, gauged to hold a known quantity. As soon as this basin is full it tilts over, discharges its liquid, and, by an index connected with the shaft on which it rocks or tilts, indicates every such motion. The compound tilting basin is so constructed that, during the brief period it is discharging its contents, and while returning to its former position, the supply still running from the cistern inside the case already mentioned, is received in a compartment thereof.

It will be understood that all pressure is neutralized by the liquid being received into a cistern, from which it trickles over into the measuring basin; and that by only admitting into the measuring apparatus a fractional part of the whole supply passing through the meter, there will be less wear and less liability to error than if the whole quantity passed into the measuring basin.

51.—Charles Barlow, of 89, Chancery Lane, London, for "*An improved registering water-meter.*" Patent dated Jan. 13, 1858.

Without the assistance of drawings this specification would be quite unintelligible.

52.—George Walker Muir, of Manchester, for "*Improvements in warming and ventilating.*" Patent dated January 13, 1858.

The improvements relate, first, to forming the pipes through which hot water is made to circulate with flanges. The pipes so formed are placed on the top of the fresh-air drain, and are thereby made to support tiles with which they are covered. The flanges and tiles have openings through which the air passes from the drain into the place to be warmed.

The improvements relate, secondly, to constructing ventilators or ventilating shafts in such a manner that inward and outward currents are produced and maintained. The shafts by which ventilation is effected may

be square, round, polygonal, or otherwise in their section, and are formed double. This is one within the diameter or circumference of the other. The outer shaft is divided vertically into compartments, but the inner is not generally so divided. The compartments of the outer shaft may be used for either inward or outward currents, but the inner shaft the patentee prefers to be used for outward currents only. The compartments are at their lower parts, or their entrance into the place to be ventilated, by preference turned into a horizontal direction, or parallel to the roof or ceiling, so that when fresh air is entering by any of them, it may not pass down in a direct line but will be deflected horizontally, whereby the force with which it enters is spent, and, the air being cool, sinks down by its superior gravity.

The ventilating means, as it appears outside of the place to be ventilated, may be made either plain or of a highly ornamental character. The inner shaft is carried higher than the openings to the upper part of the outer shaft. This top may be encircled by the outer shaft, which is then carried up outside the inner one. The compartments of the outer shaft are, however, terminated under the mouth of the inner one, and are separated therefrom.

The adaptations are peculiarly applicable when what are known as sunlights are used, and when so applied the heat from the column of hot vapour ascending the inner shaft will be partially conveyed to and warm the fresh air as it enters by the compartments of the outer shaft. If it be desired to discharge the hot vapour into the attic from the shaft as it passes through, that may be done by the inner shaft being stopped at a point within the attic and divided into smaller ones, which may be carried at a suitable line across the the compartments of the inner shaft.

The claim is for—

Forming the pipes for the conveyance of hot water for purposes of warming, and concealing or covering the same with perforated tiles in manner substantially as explained.

Secondly, the mode of constructing apparatus for ventilating apartments substantially as explained, and also the so arranging and combining parts of ventilating apparatus that the vapours generated from that description of gas-burners called sunlights, or roof-lights, may be thereby conducted from the apartment.

61.—James Alexander Manning, of the Inner Temple, London, esquire, for "*Improvements in the treatment of sewerage and other polluted liquids.*" Provisional protection only obtained. Dated Jan. 14, 1858.

This invention relates to the application and use of the refuse still liquors obtained in the manufacture of chlorine for the preparation of bleaching powder, consisting of the chlorides of manganese and iron, and resulting from the action of muriatic acid upon manganese ores, in and for the deodorization and clarification of sewerage and other polluted liquids.

This new application and use is available either in itself, alone, or in combination with other refuse substances.

By means of this invention not only is the sewerage matter clarified and the solid matter therein left available for the purposes of manure, but the sewerage is, in addition, rendered unobjectionable and innocuous in its application to the purposes of irrigation.

76.—Edwin Hills, of Warsash, Southampton, merchant, for "*An improved process for manufacturing sulphate of ammonia.*" Patent dated Jan. 16, 1858.

This invention consists in the production of sulphate of ammonia by the direct action of sulphuric acid gas on any ammoniacal liquor or vapour, such as gas-water, stale urine, bone liquor, or any liquid substance or vapour containing ammonia. In a common oil of vitriol furnace or sulphur burner, the patentee burns sulphur, sulphur ore, or substances containing sulphur, and passes a sufficient quantity of nitrous gas and steam therewith for making oil of vitriol into a large vat, chamber, or high tower, lined with lead, as in the common process of vitriol making, but taking care to use a sufficient quantity of nitre. From this vat, chamber, or tower, the inventor allows the sulphuric acid gas, together with any sulphuric acid formed, to pass in as divided a state as possible into a second vat, chamber, or tower, lined with lead, into which he also passes the ammoniacal liquor through a coil of pipe perforated with small holes or terminated by a rose, or by any suitable means, so that the liquor may come in contact in a finely divided state with the sulphuric acid gas and the sulphuric acid formed in the process at the most suitable level of the vat; or he distils the ammoniacal liquor or substance containing ammonia, and passes the ammoniacal gas in a similar way into contact with the sulphuric acid gas and sulphuric acid. A small escape-pipe is placed on the top of the second vat-chamber or tower, to give a draft to the process. By this invention a liquid sulphate of ammonia is produced, which may be boiled down and crystallized in the usual way.

The claim is for the production of sulphate of ammonia by the direct action of sulphuric acid gas on any ammoniacal liquor or vapour, as gas-water, stale urine, bone liquor, or any liquid substance or vapour containing ammonia.

PROVISIONAL PROTECTION

HAS BEEN GRANTED FOR THE UNDERMENTIONED INVENTIONS.

1372.—John Allardice, brass-founder and chandelier manufacturer, of Glasgow, and William Miller, manufacturer, of Blantyre, Lanark, N.B., for "*Improvements in gaseliers.*" June 17, 1858.

1418.—William Clibran and Joseph Clibran, of Manchester, machinists and manufacturers of "gas governors," for "*Improvements in apparatus or arrangements for distributing, governing the pressure of, and lighting gas.*" June 23, 1858.

1444.—James Alexander Manning, of the Inner Temple, London, esquire, for "*An improved mode of intercepting and treating the sewerage of London and towns and cities similarly situated.*" June 26, 1858.

1499.—John Chisholm, of Bermondsey, London, manufacturing chemist, for "*A method of disinfecting and deodorizing or treating sewerage and other matters, and structures, and places.*" July 3, 1858.

NOTICES HAVE BEEN GIVEN OF INTENTION TO PROCEED WITH THE UNDERMENTIONED INVENTIONS.

501.—Thomas Tertius Chellingworth, of Birmingham, in the co. of Warwick, civil engineer, for "*Improvements in suspending chandeliers and gas pendants.*" March 12, 1858.

1328.—George Bartholomew, of Linlithgow, N.B., edge tool maker, for "*Improvements in that description of gas-meters commonly called wet meters.*" June 11, 1858.

1413.—James Robertson, of Glasgow, N.B., machinist, for "*Improvements in apparatus for regulating the flow or passage of fluids.*" June 22, 1858.

Parliamentary Intelligence.

METROPOLITAN GAS SUPPLY.

Tuesday, July 6.

(*Continued from page* 417.)

The committee reassembled this day at twelve o'clock—Mr. Mowbray in the chair—and sat with closed doors for about an hour.

On the public being admitted,

The Chairman said: For the convenience of those gentlemen who may be present in the room with a view of tendering themselves as witnesses for examination to-day, I have to inform them that the committee have come to the following resolution:—"The committee, in consequence of the lateness of the session and of the impossibility of concluding the inquiry this year, will not proceed to hear further evidence after the examination of Mr. Slee shall have been concluded, but, at the conclusion of this day's proceedings, the committee will recommend to the House its reappointment at the commencement of the next session." We shall now proceed to hear Mr. Slee, and shall not take any further evidence to-day.

Mr. *Thomas P. Slee* recalled, and examined by Mr. Locke.

At the close of the last sitting I had completed giving evidence as to the supply of gas to the church of St. Mary Magdalen, Bermondsey. My last answer was, that the supply of gas to my business house in 1850 amounted to £41. 4s. 10d. In the following year I paid my men for over-work £128, and my consumption of gas with the South Metropolitan Gas Company amounted to £43. 13s. 2d. In the year 1854 I was supplied by the Surrey Consumers' Company. During that year my payments for overtime were £120, and I paid the company for gas £82. 3s. 5d. You must allow me to state that that year the price was advanced 6d. per 1000 feet, making a difference of about £10 upon the year's consumption, which would otherwise have been £73 instead of £82. In the year 1855 I paid for overtime working £107, and for gas £73. 12s. 10d., at 4s. 6d. per 1000. In 1856 I paid £127 for overtime working, and for gas £75. 14s. 8d. I remonstrated against these charges at a meeting of the directors of the Surrey Consumers' Gas Company, but I had not the power of leaving off having my supply of gas from them and of going to another company, the districting arrangements having taken place, by which I was handed over by the South Metropolitan Company to the Surrey Consumers'. I had, therefore, to submit to these overcharges, and had no remedy whatever, because the other companies could not receive me, as they had no mains down. I was obliged to be supplied by the Surrey Consumers' Company or go without, and they raised the price from 4s. to 4s. 6d. I have heard many complaints similar to my own among those who were handed over by the South Metropolitan to some other company. I am partly acquainted as an amateur with the nature and manufacture of gas. Some years ago I made some experiments, from which I think I am able to form an opinion as to the price and production of gas. From some few memoranda which I have since made, I find that as an amateur I produced from one pound of coal four cubic feet of gas. That of course, taking a ton, would produce 9,900 feet I also got half a pound of coke, which would be equal to about 12 or 13 cwt. per ton. I also got a small quantity of tar. Taking it upon the average, I calculate that upon a larger scale you might produce 10,000 feet of gas to the ton; a quantity of tar equal in value to 2s. 6d.; and coke, at the present price, worth about 10s. Taking the gas as 10,000 feet at 4s. 6d. it would be £2. 5s., and all these together £2. 17s. 6d. The coals for retorts, per ton, are 15s. average price, and I think it is pretty well known by those connected with gas-works that about one-third of the coal is required for heating the retorts—that is £1, and leaves about £1. 17s. 6d. as the gross profit upon the produce of a ton. If only 8000 feet were produced at 4s. 6d. per 1000, it would leave £1. 8s. 6d. as profit on the same ratio as the last. With 8000 feet at 4s. the profit would be £1. 4s. 6d. I consider therefore, upon these statistics, that the price of gas is decidedly too high. That is the only experiment I have ever made.

Mr. Locke: Do you consider that the experiment with one pound of coal acts in your favour or against you with reference to a larger quantity?

Witness: I think my calculation is under the mark, and that more might be produced by operating upon a greater weight of coal, though I think the gas would not be so good.

Mr. Locke: Have you anything further to state upon that point?

Witness: I would say that 4s. would be quite an average price: it would give the companies a good fair profit. I have nothing further to state.

Sir W. Hayter: Pray are those notes of yours lately written?

Witness: These were lately written, but my former notes are very old.

Mr. Locke: Just one question before you go on. We have heard it stated that trustees were appointed by the consumers in Southwark to protect their interests with the Surrey Consumers' Company. Are you aware of any persons—any particular persons—being appointed to perform that duty?

Witness: I had not; I knew nothing of it.

Mr. Locke: Were you ever aware of it throughout these years down to 1857?

Witness: I was never aware of it. I was first made acquainted with the fact in this committee-room. I recollect that at the time the Surrey Consumers' Company was promoted I was called upon by parties to take my gas of them, but I said I was satisfied, and would have nothing to do with them. That may account for my not knowing.

By Sir W. Hayter: I mean that I was satisfied as to the price charged. I take an interest in the affairs of my neighbourhood, but I never heard of Messrs. Thwaites, Bone, and Wade being appointed trustees. [Paper handed to witness.] I can certainly say that I have never seen this paper, which you say was circulated generally, almost universally, through the district. I am not a gas proprietor, but a consumer. I do not know the number of feet of gas supplied to the church when I was churchwarden. I can only tell that by referring to the gas accounts. I have only the churchwardens' published accounts here, which do not show the number of feet. The quarter's accounts did not contain the information. I do not know as a fact that the number of feet supplied by the Surrey Consumers' Company in the years 1854, 1855, 1856, and 1857 is of less average than the quantity supplied during the year 1852 by the South Metropolitan Company. I have not the means before me of saying whether there is truth or the absence of

truth in that statement as to the number of feet, but only as to the money value.

Sir W. HAYTER: Do you, in point of fact, know whether the quantity of feet is more or less?

Witness: It must be more, as the amount of money is more.

Sir W. HAYTER: You say it must be more. Should you be surprised to hear that it is an average on the four years of 400 feet less?

Witness: I must say I should be surprised, not having the accounts before me.

Examination continued: The prices which I have mentioned as paid by me to the Surrey Consumers' and South Metropolitan Company refer to my factory. I am supplied by the Surrey Consumers' at my own house, but I have not complained about that as I have not my papers before me. I should think the gas cost me more there, but I am not able to say. [Paper handed to witness.] This is not my writing, and I cannot say whether these figures are correct, as showing the amounts I paid at my house for the last four years. I made a complaint to the collector of the company at one time about the price charged, but I have not made any complaint to this committee, either as regards quality, quantity, or price. The Surrey Consumers' Company began to supply me in September, 1853. The meter which I had previously had in use was changed, but I cannot tell when. It was changed twice in consequence of some complaint made by myself, I believe, at the time, but I cannot say what. I think it was because a larger quantity of gas was charged for than was consumed. I have not made any experiment to ascertain the quantity of gas consumed according to the meter, and I cannot account for the greatly increased consumption except on the supposition that the gas we get is bad gas, in consequence of a larger quantity being produced from the same quantity of coal. I burn the same gas at my house, but the consumption there being small I have not taken account of that. I found that it burned badly, and I made a complaint about it, verbally, some two or three years ago. I do not know whether the increased consumption does arise from the impurity of the gas supplied; but, of course, when a larger quantity is produced from a given quantity of coal it must weaken the illuminating power of the gas, and the lightness of the hydrogen must affect the meters very much. I believe that impure gas burns more rapidly than pure gas. I have stated that, from the experiment I made with a pound of coal, I came to the conclusion that I was charged too much for my gas. The expenses which I named are not the sole cost of production; I made a fair allowance for wear and tear of works, &c. If I might be allowed to give you the evidence of a person who is well qualified to give an opinion before a committee of the House of Lords——

Objection was taken to witness reading from a book which he produced, and

Sir W. HAYTER said: We do not want the evidence of other persons, but your own. You say you made an experiment upon a pound of coal, from which you came to a conclusion that satisfied your mind that you were being charged too much for your gas. Perhaps you will be good enough to tell us what satisfied your mind, as it may satisfy ours.

Witness: If I may be allowed to read the evidence given in this book I can show you. Mr. Croll, in his evidence on the Nottingham Gas Bill, states that he produces 8000 feet of gas from one ton of coals, which cost him 8s. per ton. He takes the labour at 2s. 8d., the purifying materials at 2d., wear and tear of retorts, 1s. 6d.; and wear and tear of works and mains, 1s. 6d. He then deducts from this 3s. as the value of the residual products, and——

Objection was again taken to this evidence, and

The CHAIRMAN said: He is giving his reasons for coming to the conclusion he did, viz., the evidence of Mr. Croll. It is open to explanation by-and-bye.

Sir W. HAYTER: You are stating some other person's conclusions, not conclusions which you have arrived at of your own.

Witness: As to the wear and tear of works, &c., I take the evidence of the costs from what Mr. Croll states.

Sir W. HAYTER: Have you satisfied yourself as to every item of charge?

Witness: I have, and that the gas will cost 16¼d. per 1000 feet. That is with coal at 8s.; but taking it at the London price of coal it will cost 2s. 3d. I call the London price of coal 15s.

Sir W. HAYTER: Do you include in that the wages and labour?

Witness: It is put down so here.

Sir W. HAYTER: Does that include the expenses of distribution?

Witness: That comes in the wear and tear of mains.

Sir W. HAYTER: That is all you know about it?

Witness: Yes.

Sir W. HAYTER: What does it attribute to interest of capital—what per centage?

Witness: I think it is reckoned at 5 per cent.

Sir W HAYTER: Do you know that, or is it conjecture?

Witness: I have nothing to do with the gas companies in any way.

Sir W. HAYTER: I am not asking you that. I ask upon that assumption, do you attribute anything for interest of capital? You tell me 5 per cent. I ask you whether that is conjectural, or whether you have really in that account attributed 5 per cent. for interest of capital?

Witness: I have not taken interest at all; I have only taken outlay for production.

Sir W. HAYTER: What I understand you to say is, that the price of gas ought to be a certain sum. That, of course, must include in it the interest on capital?

Witness: I think if you look you will see that I have shown a profit of £1. 4s. 6d. upon an outlay of £1., which would cover interest and all expenditure.

Sir W. HAYTER: I ask you, do you know what is the interest upon the capital?

Witness: I do not know.

Sir W. HAYTER: Well, now, in that sum total of expenditure is the expense incurred by committees of investigation of this description included?

Witness: I know nothing at all about it.

Sir W. HAYTER: In that same sum do you include any expenditure arising from competition between the different companies?

Witness: No, I have not taken competition into the case at all, because it cannot exist now.

In answer to further questions, witness said the Surrey Consumers' Company was not established in consequence of the districting, nor to prevent districting, but to supply places which the other companies did not supply. Afterwards they resorted to districting. I have not read the several Acts of Parliament under which the companies in and around the metropolis are established. I do not know that any of those companies are confined by their Acts to certain districts.

Sir W. HAYTER: Then you would be surprised to hear that the greater part of the companies are confined to specific districts?

Mr. LOCKE: Do you know anything at all about it?

Sir W. HAYTER: I ask him would you be surprised to hear that such is the fact?

Mr. LOCKE: He would not be surprised at anything. (A laugh.) I do not think it fair to ask whether he would be surprised; that is a question of sensation.

By Mr. RUSSELL: My estimate has been taken from my laboratory experiment upon one pound of coal, from which I took very valuable results, and such, I presume, as may be depended upon. If I am correct, I think the gas companies who have shown different results must have fallen into a very great error.

Mr. RUSSELL: In point of fact, from the profitable results shown from your experiments, if correct, the companies—some of them—instead of paying no dividend, ought to have paid a dividend equal to the whole amount of their capital?

Witness: It depends upon their management.

Mr. RUSSELL: But leaving an ample margin for bad management, still the results of their working must have been enormously profitable to the companies?

Witness: I should say so, if I am correct.

Mr. RUSSELL: You will be surprised to hear that one of the gas companies, notwithstanding this remarkably fine business——

Mr. LOCKE: Name, name.

Sir J. SHELLEY: He will not be surprised at anything.

The CHAIRMAN suggested that the witness should not be asked whether he would be surprised at this or that; it was getting the notes encumbered with unnecessary inquiries.

Mr. LOCKE: The question is, do you know of such a company?

Mr. RUSSELL: The witness wants us to draw an inference from an experiment which he has made, and I want to know whether his conclusions can be borne out by what is done by the companies. I want to know whether he perseveres in the opinion he puts forth to this committee that the results which he has obtained ought to be obtained by the great companies.

Witness: I do think so, and Mr. Croll's own evidence will show it.

Mr. RUSSELL: I observe in part of your estimate that though you state you got only half a pound of coke from one pound of coal, yet upon a ton you ought to get 13 cwt.

Witness: I said a little over half a pound.

Mr. RUSSELL: Pray, sir, have you made any allowance whatsoever for leakage?

Witness: No.

Mr. RUSSELL: I presume that your results were obtained immediately close to the small retort, or whatever apparatus you had to make your experiment in?

Witness: Immediately, at the time, so that there was no waste from leakage. I have not made any estimate of loss from bad debts. I have not taken any account of the expenses of any gas company, but merely taken the cost of the produce of a given quantity of gas from a given quantity of coal. I carried on the process of distillation as far as I could to get at the rate of 9900 feet of gas. I had no opportunity of testing the illuminating power. It was simply done as an experiment.

Mr. RUSSELL: In point of fact, you cannot give us any idea of the value of your experiment. You produced a given quantity of gas, but whether it was equal in illuminating power to the company's you cannot tell?

Witness: I cannot tell. I got the gas, and it gave a very good light.

Mr. RUSSELL: I want to ask you a question upon the consumption in your house and in your factory. As soon as you discovered this very great over-consumption in your factory, your house being supplied by the same company, would not attention be naturally directed to the fact that the same thing might exist there as well?

Witness: As I before said, the consumption at my house was so small. The gas was very bad.

Mr. RUSSELL: Not so bad as to induce you to make a very formal complaint to the company. You went on paying your bills, with the exception of the passing remark to the collector, as though everything was perfectly regular and satisfactory to yourself.

Witness: I did so through indifference. Perhaps if I had paid more attention to domestic affairs I should not have done so.

Mr. RUSSELL: But if I do not misunderstand you, you do not appear to have been so careless, because you said if the committee required it you could give them the amounts paid.

Witness: So I could by looking the receipts together.

Mr. RUSSELL: Then it is quite clear they came under your attention, because you kept the receipts carefully. Now, is it not possible that the eye being accustomed to a bright light might require a still stronger light working on from time to time in your factory?

Witness: I do not think so.

Mr. RUSSELL: The general experience is, that as persons go on burning a bright light they will desire a still stronger one as the eye becomes accustomed to it.

Witness: I think not myself. But it is a most extraordinary thing that the decrease of vision should go on so rapidly and suddenly as to make in one quarter a necessity for an advance of 38,000 feet. My sight must have got very bad at a very rapid rate, for in the paper I have here the gas consumed in September, 1852, was 100,300 feet—that was the gas supplied by the South Metropolitan Company; and in the corresponding quarter of the next year, when the gas was supplied by the Surrey Consumers' Company, it was 138,700, showing an increase of 38,400 feet.

Mr. RUSSELL: I find you have made a mistake in your calculations. If one pound of coal produces four feet of gas, a ton will give 8900 feet instead of 9900 feet.

Mr. BYNG: 8960 feet.

Witness having examined his figures,

Mr. RUSSELL said: Are you satisfied, Mr. Slee, that all your other calculations are as free from error as this?

The CHAIRMAN: What answer have you to that?

Witness: It is an error, clearly so.

The CHAIRMAN: The proper quantity should be 8960?

Witness: Yes.

Mr. RUSSELL: If a gentleman of your knowledge and experience in figures makes a mistake of that kind is it not very likely you have made mistakes on other points not so much within your province?

Witness: It is possible; we are not infallible.

Mr. RUSSELL: Do you think the rest of your statements are as free from error as this?

Witness: I think they are. You will observe that I have not taken this as the basis, but a much lower standard.

Mr. RUSSELL: I simply take what we have in evidence before. You stated that the production would be 9900 feet.

The CHAIRMAN: You said the first calculation showed a profit of £1. 17s. 6d., upon the assumption that 10,000 cubic feet of gas were produced from a ton of coals.

Witness: Yes, but I reduced it afterwards down to 8000, and it left a very large margin then.

Mr. RUSSELL: You gave us in evidence that upon a large scale 10,000 feet ought to be obtained.

Witness: I think it might.

Mr. RUSSELL: Reasoning from the calculation you made?

Witness: I still adhere to the opinion that 10,000 feet can be produced upon a very large scale.

Mr. RUSSELL: Do not you arrive at that conclusion from very erroneous calculations?

Witness: No, I do not.

Mr. RUSSELL: Then from what source do you arrive at the conclusion that the companies ought to get 10,000 feet?

Witness: I suppose that as 8000 feet could be produced with a small quantity, a much larger amount could be realized on a large scale.

Mr. RUSSELL: But you told us 9900 feet distinctly, and you stated immediately following that, that as you had obtained such a result upon a small scale with imperfect means, the companies working more scientifically and in a large way, ought to obtain 10,000 feet.

Witness: Yes.

Mr. RUSSELL: Well, then, if your first calculation falls short of what it really was, will it not affect your estimate of the produce of the companies in the same way?

Witness: To the extent of a 1000 feet a ton it will.

Mr. RUSSELL: Then the evidence which you have given this committee is altogether in error?

Witness: Not altogether.

Mr. RUSSELL: I mean that portion depending upon this calculation is all erroneous?

Witness: Taking the 10,000 feet.

Mr. RUSSELL: So, in point of fact, we cannot receive any information from you on this subject, as given in the early part of your examination, upon which we can rely?

The CHAIRMAN: That is rather a conclusion to be drawn.

Sir J. SHELLEY: That is your conclusion. Put it in the shape of a question, and he can answer it.

Mr. RUSSELL: Are the committee to understand that the information you have given them rests upon erroneous calculations which are not to be relied upon?

The CHAIRMAN: That is hardly a matter for him to state.

Witness: I believe it can be done—that 8000 feet can be produced.

The CHAIRMAN: Do you conclude that, so great an error having been pointed out in your calculations, the committee can rely upon the correctness of your evidence?

Witness: I think they can. It is a mere clerical error. I put the 10,000 feet to show what the manufacture might be, but I have taken the maximum at 8000.

The CHAIRMAN: Are you sure that the rest of your calculations are entirely free from clerical errors?

Witness: I think I may say so.

Mr. RUSSELL: You have given us your evidence that the profit upon the outlay of £1 would be £1. 4s. 6d. That is £122 per cent.?

Mr. WHITBREAD: £122. 10s.

Witness: Yes, it would be; and I think, if I am right in the price of coal, I can be borne out as to that.

Mr. RUSSELL: Is that a net profit?

Witness: No, a gross profit.

Mr. RUSSELL: What is to be deducted from that profit?

Witness: Management expenses, office expenses, and expenses of conducting the business. If you allow £100 for expenses, there is a net profit of £22. 10s. per cent., which is a very good one.

Mr. RUSSELL: Do you believe that the companies can make £22. 10s. per cent. profit?

Witness: I believe they can if they are economical in their expenditure.

By Sir B. HALL: I was not aware until lately—until the districting took place—that under the provisions of the companies' Acts certain limits were assigned to them within which they might supply gas; indeed, I was not aware that the companies supplied under Act of Parliament at all. I know that in the year 1854 the metropolis on the south side of the Thames was divided into districts by the gas companies, and a district assigned to each, but I was not aware that it was by Act of Parliament; I thought it was a private arrangement among themselves.

Sir J. SHELLEY: That is so.

Witness: I understood that an Act was applied for some two or three years since, but was not obtained, to authorize the companies to supply certain districts only. The figures in the statement which I handed in, showing the number of feet of gas supplied to me in the years included between 1850 and 1857, are taken from the bills of charges made to me by the company, consequently there can be no error on that point. I have the receipts for those amounts with me. [Handed in.]

Mr. RUSSELL: Pray, may I ask, are these receipts given to you immediately after the accounts were presented to you?

Witness: When I pay them.

Mr. RUSSELL: And are you in the habit of paying very promptly?

Witness: No, I am not.

Mr. RUSSELL: Have you ever when the company have applied for the amount of your account to be paid put them off from time to time, and said, "I wish you would cut off the supply?"

Witness: I never did.

Mr. RUSSELL: You are quite certain of that?

Witness: Quite certain. I have said, "Cut off the supply, and see how I will serve you."

Mr. RUSSELL: You do not think it likely the company will be able to prove that fact?

Mr. LOCKE: He has told you what he can prove.

By Sir B. HALL: The sums which I have named as having been charged by the companies I believe are correct, and in corroboration of that I have put in the receipts. I did not take the amounts on that paper from those receipts, but from entries in my ledger. In the year 1850 the charge was 5s. per 1000, with a discount of 20 per cent; and I was charged for 106,200 feet. I have not got any account of what I paid for overtime working that year.

Sir B. HALL: You have been asked a question by an honourable member as to this point, that it might be possible that after your workmen had been used to a very strong force of light they might require a much stronger force of light; but it appears that in 1852 you had 223,500 feet, and two years afterwards 365,200 feet, being a difference of 141,700 feet; is that so?

Witness: Precisely so.

Sir B. HALL: Well, then, independent of all possibility of extra charge for defective vision or necessary increase of the quantity of gas in consequence of a stronger light having been burnt in the two years previously, can you give the committee any reason why you should have been charged 141,700 feet in the year 1854 over and above the amount which you were charged in the year 1852?

Witness: The question I answered before, and said that impure gas was the cause of the excess of consumption, which amounted to about 50 per cent. Previous to this impure gas being supplied, I was supplied by the South Metropolitan Company, and there were then in the district in which my factory is situated the mains of the Phœnix and the Surrey Consumers' Companies; so that it would have been in my power to have had gas from either if I had thought proper to do so, but I was quite satisfied with the company I was with up to the period of the districting.

Sir B. HALL: Then we come to the period of 1854, when the districting took place; and I find from the return which you have sent in, that, whilst in the last year antecedent to the districting 281,000 feet were charged for, in the first year subsequently to the districting 165,200 feet were charged. That is the case, is it?

Witness: Yes.

Sir B. HALL: It appears also that not only were you charged an increase of 84,000 feet, but were also charged 4s. 6d. per 1000 instead of 4s.

Witness: That is the case.

Sir B. HALL: Do you attribute the extra charge of 6d. to the districting of that portion of the metropolis, by which you were prevented from getting your gas from any other company except the one which the companies had decided among themselves should supply you?

Witness: I do.

Sir B. HALL: Then is the committee also to understand that this extra amount of 84,000 feet may be attributable to the inferior quality of the gas supplied by this sole company, or to other causes?

Witness: To the inferiority of the gas.

Sir B. HALL: Then am I to understand this,—that antecedently to the districting you were charged 4s. per 1000 cubic feet, and had a smaller consumption of gas charged to you; that immediately subsequent to the districting of that portion of the metropolis you had an inferior quality of gas supplied, and for that inferior quality you had to pay 4s. 6d. per 1000; that in consequence of that inferiority of quality of the gas you had to pay for 84,000 cubic feet more, as being the difference between 281,000 and 365,000; that, whilst in 1853 you had the full amount of gas you required, of good quality, at £56. 4s., in 1854 you had an inferior quality of gas supplied to you, for which you had to pay £82. 3s. 5d.?

Witness: Yes. Will you allow me one observation? In December, 1853, you will find there is an increase of 138,000 against 100,000 feet. That was the first quarter that we were under the Surrey Consumers' Company.

Sir B. HALL: Then it appears also that, taking the first quarter in which you were supplied by the sole company from which you could get a supply, you were charged 38,400 cubic feet more than you were charged in the corresponding quarter of the previous year, in which you had the power to choose from three companies which could then supply you.

Witness: That is the fact.

Sir B. HALL: It having been shown to the committee—first, that you have been charged 365,200 feet in the first year of the monopoly, whereas you were charged 223,500 feet in the year antecedent to the monopoly, and that for those quantities you had to pay £82. 3s. 5d. subsequently, as against £44. 12s. previously, can you give the committee any information as to what the cost of coal in those years was?

Witness: I cannot.

After an examination of the receipts handed in by witness, with the statement previously in evidence, and in which a discrepancy was pointed out, and the reason explained by witness to be that the statement was prepared from the invoices, which he had not got with him,

Sir B. HALL inquired: You stated to the committee that you considered the excess of consumption since the districting over and above the amount of consumption antecedently, was occasioned by the inferior quality of the gas which was supplied you by the sole company from which you could get a supply. Are there any other causes which might have led to that increased quantity—such as a greater number of burners, or a greater number of hours during which the gas was consumed?

Witness: I cannot. I had no more burners, and my previous evidence has gone to state that I paid less for overtime working with the increased consumption.

Sir B. HALL: It appears also that you have stated that in one year antecedent to the monopoly you had 218,300 feet, and you paid £128 for overtime, and that in the very year after the monopoly you were charged for 365,200 feet, and only paid £120 for overtime, so that although the overtime was greater in 1851 than in 1854, the amount of gas consumed in the previous year was less by 141,700 feet than in the subsequent year?

Witness: Yes.

Sir B. HALL: From the evidence you have given is the committee to understand this,—that antecedent to 1854, when the districting commenced, you could have got a supply from any one of three companies if you had thought fit, but that subsequently to the districting arrangements you were only able to get a supply from one company; that antecedently to the districting you considered the gas was sufficiently pure, but that subsequently to the districting you believe it to have been of inferior quality; that antecedently to the districting, with the same number of burners, and with a larger amount paid for overtime, you were charged for 218,300 feet at 4s. per 1000, whilst subsequently to the districting you were charged for 365,200, or 141,700 feet more than you were antecedently, and at an increased charge of 6d. per 1000 feet.

Witness replied in the affirmative to all these points.

Sir B. HALL: Do you consider the districting has been detrimental to the interests of the consumers generally, as far as you know?

Witness: I do.

By Sir J. SHELLEY: I reside in Russell Street, Bermondsey, and at one time the Phœnix, the Surrey Consumers', and the South Metropolitan Companies had mains there. I was not aware that within a short distance from my house the Chartered and the City of London Gas Companies also had mains laid. When I say the Surrey Consumers' Company's gas was impure, I mean that it was deficient in illuminating power, and not as the result of any chemical experiments I have made as to its purity. I have filled the public office of churchwarden in the parish. I cannot say that, as such, my attention was ever called to the public lamps of the district in reference to the illuminating power of the gas varying at different periods of the night. Lately I have observed that about nine or ten o'clock the light is less. I am

not aware whether, when the supply to theatres and other large places where gas is consumed is turned off, the light gets weaker. It was brought before the district board some two or three years ago, that towards morning, when there were only public lamps burning, the light was less. I cannot state the exact period. The companies, if I mistake not, were applied to on the subject, but what answer they gave I do not know; but that you can ascertain. With reference to the trustees, Messrs. Thwaites, Bone, and Wade, I do not know anything about their appointment by the consumers. As I before stated, I was called upon and asked to take my gas of the Consumers' Company, but I said I was satisfied, and I did not interfere in any arrangement. I have subsequently heard it spoken of as a great mystery how these gentlemen came to be considered trustees. I have never met with any one in my district who could tell how they came to occupy the honourable position of representing the ratepayers. I am not aware whether the companies are in the habit of publishing returns, or anything in reference to their affairs. I do not know whether, in answer to a return moved for by Mr. Brotherton in 1856, the London gas companies made a return of the quantity of gas made by them from a ton of coals. I have seen one or two numbers of the JOURNAL OF GAS LIGHTING, WATER SUPPLY, AND SANITARY IMPROVEMENT.

Sir J. SHELLEY: Have you seen this number (handing copy to witness)?

The CHAIRMAN: That is not evidence.

Sir J. SHELLEY: I shall make it evidence when it comes round to witnesses of mine.

Mr. WHITBREAD: I think as we are not going into that to-day it should not be referred to.

Sir J. SHELLEY (to witness): Perhaps you have seen the number of that JOURNAL for April 28, 1857?

Witness: I am quite certain that I have not.

Sir J. SHELLEY: I cannot go on then: I wish you had.

By Alderman CUBITT: I was handed over from the South Metropolitan to the Surrey Consumers' Company. I did not continue to receive gas from the same works, but I think there were separate mains. I can hardly, however, answer the question; but I think each company purchased the mains of the other company in the district which was assigned them. I do not state that as a fact, but as an impression. They supplied through the same meter up to a certain time, when there was an alteration. I was very much astonished when, on getting my account, I found such a great additional charge, and I complained about it. When I saw the directors they did not explain how it was; the only answer I got was, that as the gas had passed through the meter I must pay for it. I believed that the gas had passed through: it must have done so. I did not at all doubt the integrity of my meter, because the same meter had supplied me when with the other company. I attributed the greatly increased consumption to the inferior quality of the gas. It had not occurred to me during the previous year that such was the case; I could not account for the difference as there was nothing in the burning of the gas to lead to such a conclusion, until I saw that I had consumed so much larger a quantity. That increase might be attributable to a greater pressure at the new works, and in that case I might have had a greater quantity of light, although I had the same number of burners. I do not know that it was not so; I only know that in 1857 I paid more than I paid in 1856, and many of my neighbours made the same complaint. No doubt the company must have derived a very much larger revenue than they had done previously. The experiment which I made was by burning a pound of coal in an experimental retort.

Alderman CUBITT: As there is no difference of opinion about that point, I will not detain the committee by asking any question upon it.

By Mr. MILLS: I am not aware of the fact of my own knowledge, that the mains used by the Surrey Consumers' Company were the same as those used by the South Metropolitan Company, but I think the same mains are still down. The overtime working to which I referred as having paid for, occurred at the same period in each year.

The shorthand writer's note of the first part of witness's evidence as to his experiment was read over.

By Mr. WHITBREAD: I have corrected my statement so far as to say that I made a small mistake of 1000 feet per ton in my estimate. I stated that I got "a little more than half a pound of coke out of a pound of coal." It might be an ounce more. To give 13 cwt. out of a ton you must get 13-20ths of a pound of coke out of a pound of coal—that is to say, more than three-fifths; considerably more than half.

Mr. WHITBREAD: Then, from data altogether undefined, you feel yourself justified in considering that, in reference to a large amount, you have formed an accurate conclusion? Because, saying it is only little more than half a pound is, is saying that there is no difference between 13s. and 10s., for that is the precise proportion of error in your statement at first?

Witness: I said a little over half a pound.

Mr. WHITBREAD: The shorthand writer's note has been read over to you; if you wish to correct that, of course you can.

Witness: My note is rather more than half a pound of coke.

Sir J. SHELLEY: He stated that.

Mr. WHITBREAD: I have a perfect remembrance that he said half a pound.

Sir J. SHELLEY: He has a right to correct it.

Mr. WHITBREAD: Of course he has, and I wish to have it done. It is a slight difference of 1000 feet of gas in one case.

Sir J. SHELLEY: He is not far wrong according to a parliamentary return down stairs, and which you can get by asking for it.

Examination resumed: I cannot account for my increased consumption in any other way than by supposing that the gas was impure. I believe the burners burnt with precisely the same strength as formerly, and I have no reason at all to suspect my meter.

By Mr. BYNG: Until the districting arrangements I had no complaint whatever to make as regards either the price or the quality of the gas. Since then I believe the quality of the gas has deteriorated, and the price, according to these figures, has been increased. From my own experience, and from what I have heard from friends and other people, I believe that the districting arrangements have been prejudicial to the interests of the metropolis generally, both as regards the quality of the gas supplied and the price at which it is charged.

The CHAIRMAN: You have mislaid two of your receipts for the last two years?

Witness: Yes.

The CHAIRMAN (referring to a memorandum on one of the receipts produced): What is this—"Robbery and plunder?"

Witness: That is a remark of my own.

The CHAIRMAN: On the other side I see "Robbery by wholesale."

Witness: Yes.

The CHAIRMAN: Was that made at the time?

Witness: In 1855.

The CHAIRMAN: When was it that you made the experiment for your own amusement?

Witness: It may be ten or twelve years ago.

The CHAIRMAN: That was before the "wholesale robbery" in 1855?

Witness: Yes, when I had more spare time on hand.

The CHAIRMAN: Where did you get the coal from?

Witness: From the coal cellar.

The CHAIRMAN: What coal was it?

Witness: The best coal we have.

The CHAIRMAN: Did you make minutes of that experiment ten or twelve years ago?

Witness: I did; but I have not got the paper now with me.

The CHAIRMAN: Then you made a single experiment about twelve years ago merely as a matter of amusement, and before you had a controversy with the gas companies?

Witness: We had thoughts of erecting gas-works for ourselves.

The CHAIRMAN: Have you made any experiment since?

Witness: No.

The CHAIRMAN: Do you consider the results of that experiment twelve years ago as an amateur, and for your own amusement, so important that they can form a practical basis for the action of Parliament in reference to the supply of gas for a population of three millions?

Witness: I do.

The CHAIRMAN: Do you consider yourself qualified by the knowledge acquired from that single experiment upon a single pound of coal to inform the committee as to the maximum to be imposed per 1000 feet of gas?

Witness: I do; and I think my opinion is supported by Mr. Croll's evidence.

Mr. LOCKE: You say you think your opinion is supported by the evidence of Mr. Croll. Do you refer to a little book, entitled "Instructions to Gas Consumers," written by Mr. James Brown, late inspector of meters to the Sheffield United Gaslight Company, and published by Longman?

Witness: I do.

Mr. LOCKE: Now, do you agree with Mr. Croll in his evidence before the committee of the House of Lords on the Nottingham Gas Bill?

The CHAIRMAN: Who is Mr. Croll?

Mr. LOCKE: Mr. Croll is the person who established this gas consumers' company.

The CHAIRMAN: We do not know that.

Sir J. SHELLEY (to Mr. Locke): It's quite right—go on.

Mr. LOCKE: It is upon the evidence taken before this committee. If you turn back you will find that I asked the witness whether this company was commenced in consequence of the agitation created by Mr. Croll and Mr. Pearson in the City of London, and whether Mr. Croll established this company in Southwark; and the answer was——but I will ask the question now. (To witness:) Who is Mr. Croll—because there is an anxiety on the part of the chairman and other members of the committee to know who he is?

Witness: I have no personal knowledge of him.

Mr. LOCKE (pointing to Mr. Croll): There he is, is he not?

Witness: I have no personal knowledge of him.

Mr. LOCKE: He was sheriff of London, was he not?

The CHAIRMAN: If Mr. Croll is to be called as a witness, is it not better to have it from him?

Mr. LOCKE: I am re-examining the witness upon a cross-examination.

Sir B. HALL: The majority of the committee have prevented us from calling more evidence on this particular head.

Mr. LOCKE (to witness): You have been asked by the chairman whether, from the single experiment which you made ten or twelve years ago upon one pound of coal, you considered yourself qualified to form an opinion as to the price at which gas might be produced, and whether you gave your opinion simply upon that experiment, and I think your answer was, "No, not simply upon that, but likewise coupled with the testimony of Mr. Croll?"

Witness: Yes.

The CHAIRMAN: Was that the answer he gave?

Mr. LOCKE: Yes. (To witness:) Now, with regard to the testimony and opinion of Mr. Croll, I will just ask you whether you form your opinion upon the evidence which he gave before the committee of the House of Lords on the Nottingham Gas Bill?

The CHAIRMAN objected, and inquired of the witness: Were you present at the committee of the House of Lords on the Nottingham Gas Bill, and did you hear Mr. Croll give any evidence?

Witness: I was not, and did not hear anything.

Mr. LOCKE: Do you form your opinion upon the reported evidence in that book?

Sir W. HAYTER objected to the witness being asked about a statement made in a book, which might be true or false. You put it into the witness's mouth, and say, "Is it so and so?"

Mr. LOCKE: I have a right to do so, good, bad, or indifferent. The witness's testimony having been impugned as to the mode in which he arrives at his conclusions, I have a right to explain to the committee the exact and precise grounds upon which he forms his opinion.

The room was ordered to be cleared, and the committee remained for some time in consultation.

On the doors being opened,

Mr. *Slee* was recalled, and examined by Mr. LOCKE: Now, I will put the question—What is it your evidence states the expense of manufacturing one ton of coal into gas at Nottingham, producing——

The CHAIRMAN: What do you state the produce to be?

Mr. LOCKE: I am going to put that at the end—producing 8000 cubic feet, to be?

Witness: For coals, 8s.

Mr. LOCKE: Labour, 2s. 8d.; materials for purification, 2d.?

Witness: Yes. That makes 10s. 10d.

Sir W. HAYTER: Is that his evidence?

Mr. LOCKE: I am asking him what is the cost. Is it wear and tear of retorts, 1s. 6d.; wear and tear of mains, 1s. 6d?

Witness: Yes.

Mr. LOCKE: That makes 13s. 10d. What do you deduct from that?

Witness: Three shillings for residuary products.

Mr. LOCKE: Would that make the result equal to 1s. 4½d. per 1000 feet.?

Witness: One shilling and fourpence farthing.

Mr. LOCKE: Is that produced for less when 9000 or 10,000 cubic feet are manufactured?

Witness: Very much less; if you produce 10,000 feet it will make the cost 13¼d.

Mr. LOCKE: Do you consider this estimate to be within the mark?

Witness: I do so.

Mr. LOCKE: Can a calculation always be arrived at in this way when the price of coal, coke, and other residual products, in the locality in which

a person resides, are taken into consideration; and by that means can you arrive at a correct estimate?

Witness: Yes.

Mr. LOCKE: Have you ever read Mr. James Brown's book, pages 45 and 46?

Witness: I have.

Mr. LOCKE: And in those pages, 45 and 46, is Mr. Croll referred to?

The CHAIRMAN: That question cannot be put. What are the contents of a document?

Sir J. SHELLEY: Put it in.

Mr. LOCKE: Then I will put it in to prove that Mr. Croll is referred to.

The CHAIRMAN again objected.

Mr. LOCKE: It is a fact—it may not be a great fact, but it is a fact.

The CHAIRMAN: It is going into the contents of a written document which is not before the committee. Call Mr. Brown, if you like, on a future occasion.

Mr. LOCKE (to witness): What had Mr. Croll to do with establishing this Surrey Consumers' Company?

Witness: He was one of the movers in it, so I understood.

Mr. LOCKE: Do you know whether he is connected with it at the present time?

Witness: I believe he is, and produces the gas at so much per 1000 feet. I have heard that he is charging is. 9d., but that is only hearsay.

Mr. LOCKE: He produces the gas for the company, and they put their expenses upon it and charge their price?

Witness: That is as I understand it.

Mr. LOCKE: Is he likewise connected with another company in the City of London?

Witness: Several others.

Mr. LOCKE: Does he take contracts?

Witness: They are on lease.

Mr. LOCKE proposed to ask witness a question upon a return which he held in his hand.

The CHAIRMAN: Ask the witness whether he has ever seen such a return?

Sir J. SHELLEY: It is a document of our own.

Mr. LOCKE: It is an abstract of a return of all gas-works established under Acts of Parliament in England and Wales, and where situated; stating, in columns, the maximum charge for 1000 cubic feet of gas; the minimum charge per 1000 cubic feet; the material used; the average number of cubic feet of gas produced from a ton of coal; and the illuminating power of the light, as compared with the light produced from sperm candles. Have you ever seen that return?

Witness: I never have.

Sir J. SHELLEY: Ask him to look at it?

The CHAIRMAN: No. He says he has never seen it.

Mr. LOCKE: I submit that I may put it into his hands, and ask him whether he considers it is correct?

The CHAIRMAN: The return itself is a document which we may have evidence of hereafter for the purpose of our report, but this witness cannot speak to it, as he has not seen it. We have the document in the House, but he knows nothing about it. We can make any use of the return we please.

Sir J. SHELLEY: You have got the majority, and will not let us go on; that is the truth.

Mr. LOCKE: This witness has been cross-examined as to his knowledge of these matters, and therefore I have a right to put the question. (To witness:) Are you aware that the Gaslight and Coke Company, commonly called the "Chartered Gas Company," Horseferry Road, Westminster; Brick Lane, Old Street; Curtain Road, Shoreditch, charged for their maximum per 1000 cubic feet 4s. 6d. for Newcastle, and 6s. for cannel gas in 1857, and that their minimum charge was 4s. in the City of London?

Witness: I have not seen the return, and therefore cannot give the information.

The CHAIRMAN: Do not allude to the return, but answer the question put to you by the honourable member. Are you aware that such is the fact?

Witness: I am not aware of it.

Mr. LOCKE: Are you aware that Newcastle coal and cannel coal were the materials used by them?

Witness: I am not aware of it.

Mr. LOCKE: Are you aware that the average number of cubic feet of gas produced from a ton of coal by this company was 9000 feet from Newcastle and 10,000 feet from cannel coal?

Mr. WHITBREAD: I submit that this is not regular.

The CHAIRMAN (to witness): Do you of your own knowledge know anything of the course of inquiry?

Mr. LOCKE: I submit that I have a right to ask the question.

Mr. WHITBREAD: And I object.

The CHAIRMAN: Clear the room.

The room was then cleared.

On our return,

Mr. LOCKE inquired of witness: It appears by a parliamentary paper, No. 138—in 1857, that the average number of cubic feet of gas produced from a ton of coals by the Gaslight and Coke Company of London, commonly called the Chartered Gas Company, was, on an average, 9000 feet from Newcastle and 10,000 feet from cannel coal; that by the Imperial Company 9518 feet were produced——

Sir W. HAYTER objected.

Mr. LOCKE: I have a right to go on, and I have not yet put the question—that by the Phœnix Gaslight and Coke Company the production was 9300 feet; that by the Ratcliff Gaslight and Coke Company, New Crane, Wapping, Middlesex, it was 8500 feet; by the South Metropolitan Gaslight and Coke Company, Old Kent Road, it was 9395 feet; by the Surrey Consumers' Gas Company, Rotherhithe Street, Surrey, as the company contract for the gas which is made and sold to their consumers, they are unable to answer the questions which relate to the manufacture, and therefore no opinion can be formed upon that. But, with regard to those figures furnished by the different companies, do you consider, upon reference to your testimony, they are a correct average?

Objection was again taken to the course of inquiry, and the room was once more ordered to be cleared. After some conversation, however, the honourable member for Southwark consented to withdraw his question.

Mr. LOCKE: Have you seen that return?

Witness: I have not.

Mr. LOCKE (to Sir W. Hayter): Do you object to that?

Sir W. HAYTER: No.

Mr. LOCKE: Not having seen that return, but upon the statement of figures read, do you think it possible that can be done?

The CHAIRMAN: What can be done?

Mr. LOCKE: That that number of feet can be produced from a ton of coal. He says it can, and that this only corroborates his own opinion.

Witness: I do.

Sir W. HAYTER: What was the price of the coal from which you made your experiment?

Witness: It was from house coal.

Sir W. HAYTER: What was the price?

Witness: I cannot say; I suppose somewhere about 23s. or 24s. a ton. As a private consumer I did not buy coal at the same rate as the gas manufacturer. I dare say I could buy the same at 16s. or 18s. in large quantities.

Sir W. HAYTER: Do you know of your own knowledge that Mr. Croll had anything whatever to do with the getting up of the Surrey Consumers' Company?

Witness: I do not.

By Mr. ROUPELL: I have no doubt I could obtain the same quality of coal as that used in my experiment at something like 16s. or 17s. if I bought it as a gas manufacturer.

Mr. MILLS: What was the price of coal at the time you made your experiment?

Witness: I do not know the exact price. My calculation is at 15s., the price at which the companies are now purchasing.

Sir W. DUNBAR: If you had such perfect confidence in the result of your experiment twelve years ago, why did you not carry out your intention to erect a gasometer of your own?

Witness: The outlay for the apparatus was rather more than I could spend at the time.

The CHAIRMAN: You say the coal cost you 24s. from which your experiment was made?

Witness: I presume it might, but my memory does not serve as to what it was at the time.

The CHAIRMAN: Your memory serves you as to the quantity and quality of the gas produced, but your memory does not serve you as to the price of the coal?

Witness: I merely did it as an experiment.

The CHAIRMAN: Why do you suppose the companies now pay 15s.?

Witness: That is the price which it is now offered at.

The CHAIRMAN: Do you consider that that is of the same quality as the coal you made the experiment with?

Witness: I should say so.

The CHAIRMAN: With respect to those figures which you gave in your re-examination by the honourable member for Southwark, were they your own figures?

Witness: They were.

Mr. WHITBREAD: Not Mr. Croll's?

Witness: I back my figures by Mr. Croll's.

Sir J. SHELLEY: Only one question. The chairman has asked you something about your memory. I understood you that these figures were from memoranda made at the time?

Witness: Not with respect to the price of coal.

Mr. BARROW: You must be aware that different kinds of coal produce very different qualities of gas?

Witness: Quite so.

Mr. BARROW: And that a lump of coal of the size from which you made your experiment would probably contain a much greater proportion than the average.

Witness: It might, or it might not.

Mr. WHITBREAD: Let me ask you, have you gone into these calculations of coals at 8s., wear and tear of retorts 1s. 6d., &c.? Are they your own data?

Witness: No; I could not get at them, not having a large establishment. I merely know what was produced from a pound of coal, and I then furthered my experiment by the evidence of Mr. Croll.

Mr. WHITBREAD: Then your experiment gave you 2d. for materials for purification?

Witness: Yes.

Mr. WHITBREAD: And it brought out these figures exactly?

Witness: Yes. I only give you my figures.

This closed the witness's examination.

The room was then ordered to be cleared, and the committee remained in consultation until the close of their sitting.

MR. GOLDSWORTHY GURNEY'S PLAN FOR THE PURIFICATION OF THE THAMES.

(*Continued from page* 409.)

MONDAY, JULY 5.

The committee reassembled this day—Mr. KENDALL in the chair.

J. F. Bateman, Esq., examined by the CHAIRMAN.

I am a civil engineer, and am employed at the present time in connexion with the Glasgow Water-Works in bringing water from Loch Katrine, a distance of 35 miles. I am also engaged in connexion with the Manchester Water-Works, which are large and important ones; and I have also under my care the purification of the river Clyde, at Glasgow. The Clyde is a very offensive river, and, I think, in the heat of summer is more intensely so than the Thames itself. The evil arises from the drainage of all fœcal matter of the town and the refuse from chemical works there, which after being discharged into the river is moved backwards and forwards by the tide. I have seen Mr. Gurney's report, and I agree with him essentially. There are no mud banks in the Clyde, except in a very limited space. The river is dredged by artificial means, so as to be 13 feet deep at low water from the harbour of Glasgow right down to the sea. There is what is called the upper harbour, which is 200 yards in length, where, in certain states of the tide, a portion of the river's course is left bare; but nowhere else are there any mud banks. I think that at any place where sewerage mud lies basking in the sun it is essential to remove it. I do not, however, think that the mere removal of those banks would get rid of all the evils, at least so far as the Clyde is concerned, because the evils there do not arise in those parts where the gravel or mud exists, but in that part in which nothing but water is by any chance ever exposed to the action of the sun.

The CHAIRMAN: Do you know of any river passing through a town and emitting a very offensive smell from the sewerage which is discharged into it, but where there are no mud banks at all?

Witness: Yes; in the case of the Irwell, at Manchester, there are none; it is a constantly running stream. The Mersey and Irwell navigation receives the water of the river, and it forms an artificial system of water down to Runcorn. That is very offensive, but not so much so on account of the different circumstances of the town through which it passes, as the Clyde at Glasgow. In ordinary weather the river runs about one mile and a half per hour; in dry summer weather about a mile and a quarter. It has no tide.

The Bridgewater Canal receives the waters of the Medlock, into which probably the sewerage of about one-third of the population of Manchester is discharged, nearly the whole of which is taken in dry weather, in consequence of the want of water. There are no mud banks, and the water is about four or five feet deep, but the smell for miles and miles below Manchester is most offensive.

The CHAIRMAN: What remedy do you propose as far as the Clyde is concerned?

Witness: That at present is under consideration. In the Clyde the engineering questions are matters of considerable difficulty. The whole of the banks are covered with towns and other residential property, and to make an outlet therefore from the Clyde would be a point of extreme difficulty; and if the sewerage had to be carried away by artificial works it would be attended with enormous cost. It therefore occurred to me that if any good deodorizing system could be adopted the expense might be greatly reduced, and it might be a preferable plan. When the subject was committed to my charge I recommended that they should associate with myself a chemist of eminence, who would undertake the chemical part of the inquiry. Dr. Anderson, professor of chemistry at Glasgow College, was accordingly associated with me. Experiments have been going on for some time, and we have proved that deodorization by lime can be very fairly accomplished. But it does not seem likely to be altogether a successful project. It is attended with so many difficulties that I very soon came to the conclusion that practically it must be discarded. It then occurred to me that another chemical process might be adopted, and I urged that subject upon the attention of Dr. Anderson—viz., to use instead of precipitation some chemical agent that would operate as a solvent rather than a precipitate, and which might be placed in the sewers at convenient places, and so disinfect the sewerage matter.

The CHAIRMAN: Do you know any case in which sewerage water is disinfected by means of any acid?

Witness: Well, in Glasgow the sewers receive the refuse of a chemical work at one place, and the contents become inodorous. Indeed, it contains so much of the chemical ingredient that when this water is mixed with very foul matters from other sewers it renders the whole mixture inodorous. I do not know the reason of this; I know the fact, but cannot tell you the ingredient. Hence I infer that some disinfectant or solvent might be discovered which would remedy these evils. I do not know that I prefer this plan to a large engineering scheme for getting rid of the refuse altogether, but I found the latter would be attended with so large an expenditure that I could not recommend it until I was quite satisfied that it was the only means of remedying the nuisance. It cannot be said that the time has yet arrived for coming to that conclusion definitively, but I have a very strong impression, and Dr. Anderson agrees with me in the conviction, that the sewerage water may be disinfected *in transitu* without creating any deposit, which in a sewer is very objectionable. If we can accomplish it, not only the Clyde will be sweetened but the city also.

The CHAIRMAN: Have you given your attention to the state of the sewers in London?

Witness: Yes, I have very frequently, because the subject has been forced upon me when passing near the gully-holes. On the very hottest day of this summer I was in the highest part of London, and the smell from the gullies was very offensive, but I found the pestilential odours gradually became less as I got down towards Westminster.

By Mr. LOCKE: My attention has been occupied with the state of the city of Glasgow more or less during the last three years. I have no plan of the mode of executing sewerage works there. Up to the present time we have been trying simply chemical experiments to ascertain the fact whether by those means we could purify the sewerage in the river without any engineering scheme. If we do not satisfy ourselves in that way, this will be the next step; indeed, it is so far projected that we have been able to compare the cost of the two processes.

By Alderman CUBITT: I have no doubt whatever that the mud banks in the Thames ought to be covered over and excluded from the action of the sun, whether by the gentle slopes which Mr. Gurney proposes or otherwise, and that it would very much mitigate the evil. I do not suppose that my alternative chemical scheme would render the water at Glasgow clear; the river would look as foul as now, but it would be less noxious. All decomposition would be arrested, and, if properly done, I am told that all noxious effluvia would be prevented.

By Mr. AKROYD: I am now executing works to bring water into Glasgow from the Clyde above the influence of contamination. That water, though drawn out for the purposes of the town, would not diminish the flow, as it is all brought back again to the valley of the Clyde. Perhaps one-tenth part is abstracted in dry weather, when the river is very low; but I have here a plan by which you will see that it cannot operate prejudicially upon the lower part of the stream. In reference to the supply to London, I think about the same quantity is abstracted from the river Thames—viz., 40,000,000 gallons; the remainder is obtained from the Lea and other sources. The reason there are no mud banks at Glasgow is, that it is all deep water, which has been effected by artificial dredging and walling or pitching the sides of the river some seven or eight miles below the city. The consequence is, that the whole of the banks are always under water quite out to sea, the river is made of an equal width, there are no eddies, no retrogrades, and no brattice cesspools.

Mr. AKROYD: With regard to the dredging of the Clyde, do you find that when you dredge a channel it keeps open?

Witness: The amount of annual dredging is from 300,000 to 500,000 cubic yards. Sooner or later, according to their size, the channels will become choked up. The deposits in the Clyde do not come from the sea, but are brought down by the floods or by the discharge of sewerage into the river. The down current must always take away more than is brought in, or the estuary would fill up. Of course the greater proportion of mud consists of the alluvial matter brought down by floods. I cannot answer the question whether, if sewerage matter is held in solution by chemical means, there is any tendency to precipitate. Supposing, however, that the chemicals only hold it in solution for a certain time, I think it would get rid of the evil; because what appears to me to be the desideratum is to arrest decomposition, while at the same time you do not encourage precipitation of the sewerage waters in the sewers. Of course the insoluble portions will deposit. Sewerage matter consists of such a variety of matters, that I do not expect we should be able so to perfect the disinfecting process as to get rid of the whole; but I think there would be this advantage, that it would go into the river sweet, and most probably that would obviate the necessity for further works. Although we might get rid of the offensive odours, I do not think it would be a limpid stream.

Mr. AKROYD: You spoke of the sewers of London being more offensive on the high levels, I presume that is from the tendency of sulphuretted hydrogen to rise?

Witness: I believe so.

By Mr. PERCY: Below the Forth of Clyde there are mud banks, but they are very much mixed with sand. The sea-water comes up at times to within four or five miles below the city, and I think there is an underflow of salt water. I have made experiments to ascertain the value of sewerage manure, and the result has not been satisfactory, regarded as a commercial enterprise; but that becomes of little account when you have to take into consideration the sanitary question involved, and the great cost for engineering works. Take, for instance, London, where the estimates vary so much for intercepting sewers; I cannot help thinking that for £200,000 a year a great deal might be done. I have not been at Rugby, but I have examined the works at Leicester. There, as a commercial speculation, it is unsuccessful; and certainly, the day I was there, as a deodorizing process it was not successful.

Mr. PERCY: Does it pay its expenses?

The question was objected to by the CHAIRMAN, who said that Mr. Wicksteed would be called before the committee to explain his operations.

By Mr. PERCY: I do not know what the effect of chemical solvents might be upon fish. I doubt very much whether there are any in the Clyde at present. I have heard of Mr. Bardwell's plan at Glasgow, but I do not know that I have seen any experiments of his. I have had his plan under consideration with others. All these are processes for the purpose of obtaining a valuable fertilizing product, and I certainly do not think that at present any of them are likely to be very successful, treated simply as commercial enterprises.

The room was then cleared, and the committee remained in consultation for two hours.

When the doors were opened,

John Bennett Lawes, Esq., was recalled, and examined by the CHAIRMAN.

I am one of the commissioners appointed to inquire into the best mode of distributing the sewerage of towns and applying it to beneficial and profitable uses. In the course of our inquiry we have been to Leicester, which is a large town of 60,000 inhabitants, and having no means of getting rid of its sewerage by a large river with a strong current. Before the process now employed was carried on, the river was very full of filth, and all the fish was destroyed. Very large works were erected for the purpose of dealing with the sewerage. The process is this:—Milk of lime is applied to the sewerage which comes from the town, and which is carried into large vats. There the lime combines with the soluble parts of the sewerage, and a deposit takes place. The supernatant fluid, when the settlement has been made, is allowed to flow into the river, and the deposit is carried out and placed in large heaps. When we were there large quantities were piled up, as they could not find a sale for it. These operations are carried on, as near as I recollect, within half a mile of the town, but no ill effect is produced thereby. I am not sure whether the sewers are open or covered channels. The process of dealing with the refuse is a very simple one. The matter which subsides in the pits or vats after the application of the lime is wheeled out and removed. Various processes of manufacture were started with the idea that there would be a ready sale; some of the processes were very expensive ones; but it was found not to pay, and when we were there they were removing the apparatus. The deodorizing is a continuous thing, the liquid coming in at one end of the works and running off at the other. The building in which it is done is a very large one, with two immense tanks in the middle. I have gone into the question as far as the commercial speculation is concerned; we discussed that previously at the Society of Arts, and the issue of that discussion was that it is quite impossible to make it pay as a commercial speculation. That is my own personal opinion, as well as the general opinion of those who have studied the subject. The reason is, that it is not valuable enough to pay for being transported to any distance. I have visited every other town where any scheme for dealing with sewerage is carried on. They do not all deodorize on the same system; at Cheltenham they merely filter the sewerage.

The CHAIRMAN: Which of the two is the best mode of proceeding?

Witness: In a town like Cheltenham, where you have an outfall at some distance from the town, I think the system pursued there is superior to that adopted at Leicester. I have examined that also as a commercial speculation, and the information I received was that it nearly paid its expenses. They simply filter the sewerage and mix it with the refuse of the town, and sell it to the farmers at 3*s.* and 4*s.* a ton. I think they said that if they could sell it for 5*s.* it would pay its expenses. At Tottenham the same process is adopted as at Leicester. At Croyden they are breaking up their process. I know of no others. As far as I know, wherever it has been tried as a commercial speculation it has failed; but, generally speaking, it has succeeded as a cure for the sewerage nuisance. Having seen it carried out on a small scale, I think it would be applicable on a large scale in London. The mode in which I should recommend it to be carried on here, is by carrying the sewers into large tunnels to be formed in an embankment of the Thames, and mixing milk of lime with their contents. The insoluble portions would be thus precipitated and might be pumped away, while the clear liquid might be allowed to run into the Thames. I should think there is plenty of waste land in the country where the solid refuse might be placed without injury. There is a wide difference between manufacturing it at so much per ton and delivering it on wastes and converting that into fertile land. You must carry it somewhere. If you cannot do that, or make merchandise of it, you must carry it into the sea. In that case it ought to go distinctly into the sea. Although deodorized it is not made perfectly harmless, and if exposed to air and water it would putrefy again. I am afraid that if it was placed in the river some distance down it would come back again. I think it quite feasible in the first place to deodorize all the sewerage that is created in London, and then to carry it all to sea by means of boats. Some of the engineers of the commission have estimated the expense of the whole scheme, including the cost of carrying the solid sewerage away a distance of twenty miles, and I think their estimate was given in the report.

By Mr. TITE: When we were at Cheltenham they were using a small quantity of lime after filtration had taken place; but in the main, the plan there adopted consists of a mere mechanical deposit, without any chemical agency at all. It is found to be a valuable manure, and they get rid of it easily.

Mr. TITE: It has been suggested here that the sewerage of London abounds so much in protoxide of iron that it is rendered useless as manure. As a chemist, is that your opinion?

Witness: No, certainly not.

Mr. TITE: Why? Is not the opinion that the protoxide of iron is mischievous to land well founded?

Witness: I cannot conceive that it exists; it must become peroxide, which is harmless. My acquaintance with the subject is theoretical, not practical, as I have never used London sewerage. The supernatant liquid, which contains urea and most of the elements of ammonia, would not, by being allowed to flow into the Thames, produce any injurious effect. I think it would be better to get rid of everything altogether if you could; but there would not be much to complain of if you got rid of all the insoluble matters and allowed the others to remain. The fact of the ammonia remaining in the water would very much diminish the value of the deposit as a manure.

Mr. TITE: You see the importance of the former question. If you are going to take this deposit away in barges, and put it on land where it is to be of some use to the parties who take it, you are more likely to get rid of it than if it was so much sand placed upon low lands which want raising. I want you, therefore, to tell us whether you think this deposit of sewerage would be useful as manure to farmers?

Witness: I think it would be highly so. I have no doubt about it.

Examination resumed: I should mix the lime at the very mouth of the sewers, running them into this embankment, and allowing the contents to settle there. In carrying out the embankment, wherever there were mud banks and no wharves, the space between the embankment and the shore would be filled in solid. The interior of the embankment would consist of two tunnels of 22 feet diameter, which would be bricked over and made tight; the sewers would be carried into them, the contents being mixed with cream of lime as they ran in. In traversing the tunnels all the insoluble matters would precipitate at the bottom, from which it would be carried away. Wherever there are wharves there will be docks created within the line of embankment, the entrance to which will be by gates, which would close at certain states of the tide. These tunnels will run continuously within the embankment, and will be made of brick 22 feet wide, the top of them will be 24 feet above low water, and they will hold all the sewerage and rainfall, taking it alternately—one precipitating while the other is receiving. It takes a certain time for the lime to act and cause the deposit. From these tunnels the water would be discharged into the river, and the accumulation of solid matter pumped into barges. I think the water in these docks would deposit mud in the same way as in other docks, but there will be no sewerage in it. The mode of getting rid of that mud has been discussed in the commission. I cannot speak to the expense of this plan, but the engineers are quite prepared to go into that question. I do not imagine that a system of deodorization could be applied to the mouths of the sewers themselves, so as to let the matter run at once into the river. You might do it for a temporary purpose, but not for a permanency. You must have an immense place to receive not only the sewerage, but the rainfall; and I do not see where you will find such a space, unless you have an embankment. The space in the embankment we propose is ample to take in all the sewerage and an inch of rainfall in twenty-four hours. Less than that I think would not answer. It is very important to have as much rain as possible, for it is proved that the sewerage of the day does not run into the Thames, but accumulates in the sewers until the rain carries it down. The amount of deposit is about 400 tons daily, which must be got rid of somewhere. We propose to pump it through a pipe; it is not solid, but in a state of slush; and we propose to pump it 1 in 50. I think a tract of land might be found down the South-Western line, which perhaps is not worth more than a few shillings an acre, where it might be deposited. There must be pipes laid down with branches when you get to the district.

By Alderman CUBITT: The two culverts which we propose would be above the level of some of the sewers, and all that will not run in by gravitation must be pumped in. I think it would not necessitate the alteration of the present arrangement of the sewers, but I should not like to answer that question. The whole of the sewerage would be deodorized, but I think when the sludge got into the country it would smell, and you would require a patch of ground for the purpose of depositing it on. The water which ran out into the river would be clear, though there would still be urea and other impurities in it; but I think there is nothing which by the aid of chemistry could be got rid of. [Witness handed in plan of proposed embankment, which he said would be continued from Westminster to within a short distance of Southwark Bridge.]

By Mr. AKROYD: By the Leicester process of deodorization you have half the weight of the solid product in lime, which is of no value as manure. In Cheltenham you have the ashes of the town, which are valuable for that purpose. The process of filtration is slower than that of precipitation. I think the best course would be to precipitate as much as possible without lime, and use lime at the end of the process; that is the mode they adopt at Cheltenham. The supernatant liquid loses most of its offensive properties even at Leicester, and it has been found that fishes which formerly would not go near the town do go now, which is a proof that the water is clear. There would be no great difficulty in getting rid of the iron brought into the sewers from the streets, because the heavier matters would sink to the bottom of the culverts. If the sewerage were delivered in the same proportion every 24 hours, the question could be easily settled by having iron tanks or barges at the mouths of the sewers, into which the solid matters might be placed and the filtered waters run off into the river; but during heavy floods, when each sewer was running 30 or 40 times its ordinary quantity, you would have no space for filtration and deposit. I think precipitation and deodorization are the nearest approach to a solution of this question that I have seen.

By Sir B. HALL: The works at Leicester were planned on a much larger scale than necessary, but I do not recollect what the area covered by them is.

Lord J. MANNERS: We shall have that from Mr. Wicksteed.

By Sir B. HALL: I should think there was not an acre in use, but a larger space was covered over, and there are fields on three sides of it. The level of the tunnel which we propose to construct in the embankment will be a little below low-water mark. What they call the high-level sewers, which now run into the Thames above low water, will discharge into the reservoirs by gravitation; those which do not so discharge will be pumped in.

Sir B. HALL: Have you and your co-commissioners made such calculations that you are able to assure the committee that the tunnels are so formed as that the sewerage matter which comes down the various sewers can all be carried away without being thrown back up the sewers, rendering it necessary to have an increase of the height of the present invert of those sewers?

Witness: Our calculation is to take the whole of the sewerage and one inch of rain in the whole of the urban area; but I should prefer that these questions were explained by the engineers.

Sir B. HALL: But if your tanks are not sufficient to contain all the sewerage which may run down, and if the level of the tanks are higher than the level of the existing sewers, you must have a back water of sewerage which may run up the sewers any distance?

The CHAIRMAN suggested that the engineering part of the commissioners' report was one upon which the witness could not be expected to give evidence, the chemical questions arising in the course of the inquiry being those which more especially belonged to him.

Sir B. HALL said he presumed that this was at the root of everything, and must have been a point to which the attention of the committee was particularly directed. He inquired again of the witness whether they had considered how far the back flow would be?

Witness: The sewers are now backed up at high water, and it will not affect it beyond that point. I believe the sewers have stop-gates. Deposition by lime is our proposition, but I think eventually a great deal of filtration would go on. This could be done by merely dividing the reservoirs in the inside. The filtration at Cheltenham is not a lateral filtration, but is effected by means of straw and hurdles. The object of it is merely to save the expense of the lime. The 20,000 tons of slush would be pumped by the aid of steam-engines along the pipes. Pipes of something less than three feet diameter would carry the whole. We have discussed two or three points at which the discharge should be effected, but we have thought if it is to be used for land it could not be done unless the Government purchased a piece of waste land on which to deposit it, and not to depend merely on the chance of selling it. It is not necessary that land should be bought, because you may pump it into the sea; but if it is to be made use of for agricultural purposes I do not think you can trust to indiscriminate sales. No sites were before the commissioners as places where this great quantity of slush could be thrown when pumped, but it was thought there was some very bad land in the south-western district, about twenty miles from the metropolis. They felt there might be some prejudice against coming nearer. The estimate in their report allows for twenty miles of distance and fifty miles of piping altogether, without going to any expense for distribution. The whole estimated cost of the plan is £3,250,000.

By Mr. PERCY: There would be space enough at the mouth of the Ranelagh sewer for works like those at Leicester, in order that the experiment might be tried there. I did not observe any offensive smell at Leicester until they came to move the slush about. The heaps I spoke of were rather offensive; they were not so wholly deodorized that you could leave them about in a town. I do not know of any chemical process by which the matter could be made valuable. The pipes which we propose to use are iron. I think the process of oxidization of the pipes by the passage of the sewerage would be a very slow one. I am not aware of any experiments having been carried out by which I could estimate the amount of iron in the mud of the Thames.

By Mr. STEPHENSON: The material at Leicester is almost wholly valueless, and it would be so here. The term "value" is one which may convey different ideas to different people. By value at Leicester I mean you could not sell the material as manure; but if you can buy land which is sandy at about £5 an acre and deposit it there, you would be able to sell that land at a much higher value.

Mr. STEPHENSON: Suppose, instead of deodorizing works upon the Thames, you could intercept the sewerage a few feet above the river at such a level as to be capable of being carried down to Barking Creek or the Essex marshes, could you not have the material conveyed to land that wants the manure, by gravitation, without any pumping at all?

Witness: If you could use the sewerage water by irrigation, that is the best plan of all. The objection I have to the Essex marshes is that they are all very rich alluvial soils below the level of the Thames. They are exceedingly valuable now and do not want raising, though I know the drainage from them is very imperfect at present.

By Mr. ROUPELL: The deposit in the docks between the embankment and the shore will be simply mud, if you get rid of the sewerage from the river, and it would be comparatively inoffensive and harmless. I know some portions of the Essex marshes; I am not aware that much of the grass land there owes its value to the fact that it is below the level of the river. I think it owes it to the nature of the land itself. I have seen in excavations made there that the vegetable matter is twenty feet deep. It is no use trying to improve land worth £80 an acre; but upon such land as you find at Bagshot Heath, worth £4 or £5 an acre, if you put a deposit upon that of some feet thick you will make it worth considerably more.

By Sir J. SHELLEY: In this deposit a large quantity of the ammonia, which is valuable to the farmer for his straw crops, is taken out. I should place it on the land I speak of, perhaps a foot deep. I think after being warped it would be ready for cropping in a year, as, being a substratum of sand, it would filter through. In conveying this slush I do not think there would be a deposit in the pipes, because we should be continually pumping. If the material were taken away in barges there would not be nearly the quantity that there would be if pumped, as it would be removed in a more solid state. I do not think that the ashes used at Cheltenham tend to fix the ammonia.

The CHAIRMAN: Before I clear the room, perhaps I may be allowed publicly to state on behalf of the committee that we are under considerable difficulty as to what answer we should give to the various persons who apply to be heard here. For myself, and I presume I am in the same condition as the other members of the committee, I have done the best I could to answer the letters which I have received, until I found that I had such an accumulation that it was physically impossible to go through them. The other members of the committee are in the same position. We have decided to do this—that, as the session is short, we shall, to the best of our ability, select such evidence as we think right to call before us. It may happen that we shall not call those persons who are the most efficient or the most able; but under the pressure of circumstances, being unable even to read all the letters that come to us, the public will, I hope, think that we are only doing our best in selecting those persons we do select, considering the short time we have to prepare a report before the House adjourns.

THURSDAY, JULY 8.

Mr. *Maughan*, examined by the CHAIRMAN.

I am a consulting chemist, and for nearly forty years have given my attention to chemical studies, and have published several works upon it. I am aware that one part of Mr. Gurney's scheme has reference to the burning of sewerage gases. I have given a great deal of consideration to the subject, and have, in conjunction with Mr. Thompson and Mr. Gurney, made some experiments upon it in this House. I yesterday examined the air in the sewers, and I found that this piece of paper, which is the ordinary test-paper, prepared with acetate of lead, after being exposed to that air for three hours, became discoloured in this way. After the gases were burned, this other piece of similarly prepared paper, when exposed in the chimney or draft, was not acted upon in any way, showing very clearly that the air is improved by passing through the furnace. Upon an examination of that air pneumatically, I was astonished to find that though it smelt very strongly of sulphuric acid from the combustion of the coke, it contained 21 per cent. of oxygen. Mr. Thompson examined the air at the top of the shaft, and found a deficiency of oxygen. I have no idea of the distance from which the gases were drawn, as I am not acquainted with the geography of the sewers. The draught in the chimney was at the rate of 10,000 cubic feet per minute, and the combustion is perfect. I have come to the conclusion, as the result of my experiments, that Mr. Gurney's plan of burning the gases would be most beneficial if applied generally to the sewers and at a moderate expense also, as after the erection of the machinery there would only be the expense of the fuel; but I have made no calculation as to what that expense would be. If the gases were burned and the mud banks obliterated, a great deal of the present evil would be got rid of.

By Mr. AKROYD: The gases are burned at a low red heat. The oxygen to which I referred comes from the air in the shaft, the whole of which does not pass through the furnace.

By Sir B. HALL: The sewerage refuse must undergo decomposition some

time or other, and, therefore, I could not undertake to say that, if poured into the river after the gases arising in the sewers are destroyed, it would not smell eventually.

By Mr. PERCY: The sewerage matter in the river does not undergo putrefaction so rapidly as in the sewers, because it is more diluted and the temperature is much lower.

By Mr. LOCKE: The air as it comes from the sewer has been tested by Mr. Thompson, and I have witnessed many of his experiments.

By Sir J. SHELLEY: At the time the experiment which I conducted was made, I believe we were drawing air from this House. I cannot give any information as to the effect of burning the gases upon the neighbouring sewers.

Mr. *Gurney* was recalled to explain the construction of the shaft. He stated that when the door in it was closed all the air came from the sewers, and that was the case when Mr. Maughan's experiment was made.

Examination of Mr. *Maughan* continued by Mr. LOCKE: The object of using steam in connexion with this process is this: the steam arrests the gases, and forms a sort of flux for them.

By Sir J. SHELLEY: There is no danger from explosion in the operation. Many of the explosions which have taken place in sewers have not arisen from the gases generated there, but from the leakage of coal gas into them.

William Haywood, Esq., examined by the CHAIRMAN.

I am the engineer to the City Commissioners of Sewers, and have been so for thirteen years. I have given considerable attention to the ventilation of sewers. I have read Mr. Gurney's report published in the parliamentary papers a year ago, and I am aware that a part of that report relates to a plan for having closed sewers down to low-water mark, and that he proposes to burn the gases. I have not made any experiments myself as to the burning of sewerage gases, but I have examined, to the best of my belief, all the experiments which have been made both in France and in this country. I have recently reported to the commissioners upon the ventilation of sewers. As to the practicability of doing so by means of furnaces, my impression is that there would be very great difficulties in doing it at all, and that, if it could be done, it would be only at an enormous annual expense. The difficulties to be overcome are gigantic, and at the present moment there are no data of sufficient value to enable us to make anything like an approximate estimate of the cost or of the number of shafts. The great expense would be the extracting of the air from the sewers, the quantity of which is very considerable—probably much larger than most people are aware of. If it were simply the extraction of a given cubical quantity—a known quantity—of air, the data which have been obtained in the ventilation of collieries would apply precisely, and it would be a simple question of how much coal and how many furnaces would be necessary to exhaust that given quantity of air. But the difference between a mine and a system of sewers is an essential one. A mine has but one inlet and one outlet—or if more it is practically so arranged—but a sewer has thousands. Probably there are not less than 12,000,000 to the sewers of London. In the City alone I can speak in relation to that which is under my own control, and the information there obtained will give some approximate idea of the total number. In the City there are 48 miles of sewers, 1065 air shafts with ventilators, and 2810 gullies of every description.

Lord PALMERSTON: What do you call an air shaft?

Witness: An air shaft is a small shaft which rises from the crowns of the sewers and terminates at the level of the street, and the object of them is to allow a sufficient quantity of air to enter the sewer as to render it safe for men to work in. It is from those shafts or ventilating gratings that the stinks in the streets are occasioned.

Mr. LOCKE: What are the gullies?

Witness: They are the inlets for the surface-water, though in a large portion of the metropolis they positively act as ventilating gratings, because they are not trapped as they would be in a well-arranged district. In addition to these 2810 gullies, there are 43,944 other inlets—such as sinks, water-closets, rain-water pipes; so that in the City of London alone there are altogether 47,819 inlets of every description.

Mr. TITE: That is about 1000 per mile?

Witness: Taking the length of the sewers in London as about 1500 miles, you will find that that gives about 960,000 inlets. Call it 1,000,000 in round numbers; and it is that 1,000,000 of inlets which constitute the difficulties of treating the sewers in the same way you treat a mine, because, unless you cause every one of these inlets to be hermetically sealed, which is impossible, as their object is to let things pass through them, the leakage would be so considerable that—in fact, there are no data by which you can calculate what it would be. My impression is, that if it could be done at all—that is to say, if the leakage did not beat you—that £60,000 a year would not pay the cost of ventilating the sewers; it might be £100,000, and I cannot say it would then be effectual.

The CHAIRMAN: It comes to this, then—you think it is not possible to carry out the trapping to the full extent, and that if you could do so the expense would be enormous?

Witness: That is the conclusion I have come to in the absence of any well-tried experiments to oppose it.

The CHAIRMAN: And that, from the number of these gully-holes, you cannot form an approximate estimate of what the expense would be?

Witness: It is impossible, because all those openings are continually varying their conditions. Supposing you have got a certain length of sewer, and the exhausting power so well arranged in relation to the work to be done that you have a decided down-draught from every one of these inlets, and that so complete that it is superior to the diffusive power of the gases (what it may be I cannot say, but you cannot start with less than two miles), the mere opening of a water-closet, the fitting of a new drain into that sewer, a servant taking up a bell-trap in a sink, or the sewer-man leaving up a side entrance, would entirely destroy the effect of the whole system. Therefore, unless you have a gigantic power to guard against all these casualties, the system will be a failure as a perfect system, though you might, perhaps, do something.

The CHAIRMAN: Supposing this difficulty got over, and you could burn the gases—what is your opinion as to the effect?

Witness: My impression is, that if you can discharge these gases at a sufficient height above the ordinary level of the atmosphere we breathe, you might do so without any harm; but as to the possibility of burning the gases, a chemist must be a better judge than I can be. My impression is, that there is very little probability of your burning them so as to deprive them of all smell. In all these things you may do a little, but you want to do it perfectly; and the question is, if you cannot, how far is it well to do that little. If you discharge these gases from furnace chimneys, a large quantity must pass through the fire; and if this system of ventilation is ever to be carried out, the furnaces must be so arranged that there should be no sewer in connexion with them but what would feed the fire. My impression is, that very little, if any, of the noxious gases would be burned; but I am scarcely competent to give you an opinion as to the action of the steam-jet in connexion with the furnace. Chemists think that it would be superior, but my impression is, that it is only superior by comparison.

By Mr. ROUPELL: The effect of a current of water is to carry with it a current of air, depending upon its velocity. To a certain extent that holds good in reference to a sewer. There are offensive smells from the gully-holes of those sewers where a current of water is always flowing, arising from the decomposition that is going on. It would be impossible to pass any sufficient quantity of water through a sewer as to destroy all decomposition. In the largest sewer in London (the Fleet), where there is a flow in the middle of the day of 1600 or 1700 cubic feet, running with a velocity varying from 2¾ miles an hour in some parts to 4 miles an hour in others, there is yet a great stink coming from the gullies; and the current of air immediately in contact with that large body of water is only sensibly affected to about a foot or a foot and a half above it. It is a tide-locked sewer necessarily—the tide runs up; but there are not more offensive odours when the aperture is water-logged by the river than at any other period, excepting as it is affected by the external atmosphere and by the condition of the barometer. I do not say that the velocity of the current in a sewer has nothing to do with the ventilation, because everything which prevents stagnation must aid ventilation; but, practically, it has nothing to do with the prevention of stinks from gullies. Undoubtedly, a stagnant sewer would be more injurious to the health of the inhabitants of a locality than a sewer where a current was flowing; but neither from the current of air or water in a sewer do I consider that the offensive smells would be entirely got rid of, and only by a great annual outlay could the nuisance be materially mitigated.

By Mr. TITE: For the ventilation of the sewers in the City we depend entirely upon the air shafts in the streets, with the exception of one or two pipes carried up experimentally by the sides of houses. You can enter any of those sewers without danger to life, excepting occasionally when explosions of coal gas take place in them. I never experience any danger myself, nor have any of my assistants. The explosions which have taken place in the City sewers have arisen, not from gases generated in them, but from leakages in the gas-pipes, which have collected in the upper parts of the sewers and exploded there. I have not gone into the question closely to know how many chimney shafts would be required in the City of London alone, but I think most probably it would be eight at the very least; it might be double that number. The first difficulty to be overcome in burning the gases is the prevention of leakage into the sewers—admitting the air where you do not want it, to the exclusion of it where you do want it. In addition to the expense of these eight shafts, with furnaces, to exhaust the atmosphere of the City sewers,—assuming, for instance, that the whole of the atmosphere had to be emptied every eight hours, that is, three times a day,—I do not think it could be done under £2000 a year. That is making no allowance for the great leakage, which I think would be fatal to the scheme. I beg it to be understood that this is not an estimate upon the correctness of which I pledge my reputation; all I will pledge myself to is, that it is rather under than over the mark. I say it will cost £2000 for the City sewers; and if you take those as about 1-30th of the whole of the metropolitan sewers, it will come to £60,000 for London generally. There are also other difficulties to be provided against; and among these one is that the men must work in the sewers, and therefore the atmosphere must be in such a condition that they can do so; and if you have very few shafts, then the velocity of the current in many of the sewers as they approach the point of efflux would be so great that no human being could stand in it, but it would literally blow them away. The temperature of the sewers varies at every season of the year. With an external temperature of about 60°, the mean internal temperature of the sewers would be about 62°. The result of a series of observations upon the temperature gives the mean atmosphere of the sewer as 3° above the external atmosphere during the summer, and in the winter about 11° above it. In the spring, with an external temperature of about 53°, all the sewers are about the same; and in the autumn, with an external atmosphere of about 60°, the temperature of the sewers is about 3° above; so that the variations in the sewers are not so great as in the external air. The current of the air is so slight in the sewers that it is almost impossible to measure it, except immediately in communication with a large body of water running with great velocity, as in the Fleet. Speaking from recollection, when the water in the Fleet was running with a velocity of four miles an hour, the velocity of the stratum of air just above it was two miles an hour, and eighteen inches above there was no action at all. Nothing you can do in the way of ventilating the sewers will in the least affect the state of the river. I am acquainted with the experiments made by Mr. Gurney in 1849 in the Friar Street sewer.

Mr. TITE: The result there, as reported by Mr. Gurney, was, that the sewer was efficiently ventilated, and the current was sufficiently strong to extinguish a light. That was, I suppose, by an up-cast shaft?

Witness: A furnace was simply established in the end of the sewer, without any shaft. But the experiment there furnishes no information upon the practicability of ventilating sewers generally, the circumstances of that sewer being so exceptional. That was a sewer constructed with a fall the wrong way, and without an outlet. The old Commissioners of Sewers intended to complete it, but they were superseded before they could do the work. The sewer was 1500 feet long and came to a dead end; and therefore the sewerage, when it commenced running in the direction of its gravity, soon came to a stop. In fact, it was a long cesspool, with no drains entering into it, with no gullies, and no collateral sewers. The consequence was, it was like a long tube without an opening, and of course you could ventilate it with a pump, or jet, or anything else. There was a brattice line made, and the fresh air was sent down one side while the foul air escaped at the other. That sewer was hermetically closed except at this outlet, where the furnace was placed. I am only acquainted with the ventilating experiments made in this House in 1855 from the parliamentary papers. [Witness was further examined by Mr. Tite as to the local circumstances of some of the City sewers.]

By Alderman CUBITT: The extension of the outlets of the Fleet and Paul's Wharf sewers, below low-water mark, entirely clears the shores of sewerage matter, and does not in any way affect the atmospheres of those sewers. Therefore, as regards that point, there is no objection to dealing with all the sewers on both sides of the river in a similar way.

By Mr. AKROYD: We have sometimes flushed the sewers by damming the water up to a certain head-line with iron gates, and then opening them. The supply of water to London is sufficient for all practical purposes. Flushing, I may say, is an expedient resorted to for correcting an inherent defect in a sewer, and not an expedient to be adopted if you can do without it. It is to correct the evil of a want of sufficient declivity or want of water in a sewer. When you discharge the dammed-up water you clear away the fœcal deposit, and so far improve the atmosphere of the sewer; but in no other way do you benefit it. I have spent days in the sewers of Paris. The water supply in that city bears no proportion—it is not one in four of the supply to London, and the consumption of the houses is not one-ninth. The sewers of Paris, which have an essentially different smell to those of London, are ventilated, not by ventilating shafts, but by gullies at the side of the

footways, none of which are trapped. I do not know the sewers of Rome at all. We do not flush in the City of London now, as nearly all the sewers keep themselves clean.

By Sir B. HALL: Cesspools are not universal in Paris, but the fœces of the inhabitants are collected in some way or other. There is a vast quantity of fœcal matter going into the sewers of Paris, but nothing like the proportion there is in London. In fact, their system is fundamentally different. The law, which is very strict, is nevertheless evaded considerably there; but a great portion of the fœcal matter is carted away every night. The local evils which were remedied in the City of London, by extending the outlets of some of the sewers below low-water mark, were those arising from the discharge of sewerage in a concentrated form near some wharves and a landing-place for steamboat passengers. The sewers are not, from that circumstance, hermetically closed—every one of them has ventilating shafts into the streets, and no difference can be detected in the smells arising from those sewers to those whose mouths are not covered. I believe that sewers which are sufficiently ventilated in other respects will not send a larger amount of bad air into the streets because their outfalls are trapped to below low water. Perhaps, theoretically it may be that they would do so, but practically it would be insignificant; because it must be recollected that many of the other sewers are hermetically closed with hanging valves, which only open to allow sewerage matter to escape.

By Mr. STEPHENSON: I am familiar with the general principle of ventilating coal-mines. I think, by a large outlay both of money and of skilled labour, you might so isolate a given district of sewers in London as to make a fair experiment to ascertain whether you could assimilate their condition to that of a coal-mine; but whether you could apply the principle to so many square miles of sewers as there are in the metropolis I cannot say.

Mr. STEPHENSON: That is just the answer I expected.

Witness: I am afraid the experiment with furnaces would prove a failure, but I should like to see £2000 or £3000 spent upon it. Applied only to a single district it would require a very systematic arrangement, by which the sewers should not be allowed to be indiscriminately connected with each other. It would require close consideration of every sewer in the district, and domiciliary visitation of every house to see whether the traps were kept in a state of tightness. In the details of many of the sewers it would require an entire alteration of the present system of sewerage.

By Mr. PERCY: I am utterly at a loss to suggest any better means of ventilating sewers than that at present in use. I have examined the question with the greatest care, and, though I am compelled to state that the present system is very far from a perfect one, yet every proposition to improve ventilation is met by hosts of difficulties, which look perhaps insignificant at first, but which become so formidable at length as to be invincible. I am afraid we must still let the stink out into the centre of the carriage-way, as we do now, taking care that the sewers shall be kept in such a state of attention that all the exuvia is hurried away as quickly as possible. The smell from the gully-holes of the metropolis has been essentially altered during the last few years by attention to the internal construction of the sewers, by the improved water supply, and by additional labour. It has been suggested as an experiment that the rain-water pipes of houses might be employed as ventilators, and to see whether they would answer the purpose I carried up a few. It has also been done in some provincial towns, where it has answered so far as this—that instead of having the smell in the streets, they have had it at the tops of the houses. If you carry a shaft up 250 feet high, I cannot conceive that with the enormous diffusion of gases any harm could arise. In all these questions there are two or three simple facts which are kept out of view, one of which is the amount of diffusion by the current of air over London, which must destroy the effect of any stink. When you consider at the present moment the whole of the atmosphere of the metropolis is moving with a velocity of five miles an hour, at least 500 feet high and 10 miles wide, you will see that it must have a wonderful effect, and therefore I think that with such shafts the smell would be inappreciable; but merely to carry them up to the sleeping apartments of the inhabitants will not benefit them much. I have very little information respecting the experiments made at Brussels, but I believe they were precisely the same as those at Paris and in the Friar Street sewer, which does not aid one in the slightest degree in forming a judgment upon the subject. By experiments at the mouths of the sewers it is ascertained that sometimes there is an out-draft and sometimes an in-draft, depending upon the state of the wind. In calm weather there is frequently as much smell from the outlet as from a good large ventilator, and no more. At Croydon, where there is a system of pipe sewerage, I am informed by the medical officer of health that almost invariably, with the furnace at the lowest part of the system—though the district being newly sewered it was in the best possible condition—the draft was up the sewers rather than down.

By Lord PALMERSTON: Some of the gases disengaged from the matters in a sewer are lighter, and some heavier, than atmospheric air; but chemists can of course answer that question better than I can. I believe that nearly the whole are specifically heavier. The fact of their rising out of the gullies and water-closets is owing to the law of diffusion, which will cause gases of the most diverse specific gravities to mingle with each other. Professor Graham, in his work on chemistry, states that, if you take two phials, and fill the one with a light and the other with a heavy gas, and keep the heavier one down low, in the course of a short time those gases will mingle, and form a gas of uniform gravity, and nothing earthly can separate them except chemical analysis. The principal sewerage gas is sulphuretted hydrogen, which is heavier than air; but the tendency of all gases is to rise, whatever may be their specific gravity. If the sewers were continually running full, and no external air could get to them, I apprehend decomposition would not set in. Sewers should not be made too large undoubtedly, but you cannot say what the proper size of a sewer is, the conditions in each vary so materially. Sewers perform two functions—they take all the sullage-waters of the population, and they also take the storm-waters; and, during the greater part of every period of time they do not take that proportion of water that they will be expected to do on certain occasions; and it is just at the time when they are not carrying the larger quantity, that the sewerage is the most concentrated and the worst smells take place. If a furnace were established at the mouth of a sewer to draw the gases out of it, the place of those gases would be supplied by the air carried through the apertures in the streets. So far as it succeeded it would relieve the houses and streets from escapes through the gullies, &c., but I think the benefit to be derived would not compensate for the outlay.

By Sir J. SHELLEY: The estimate of the cost of ventilating the sewers has been arrived at without very accurate data. I have done it in this way. The bulk of the cubical capacity of the City sewers I take to be 3,300,000 cubic feet. If you assume them to be exhausted eight times in twenty-four hours, it will give you, in round numbers, 26,000,000 cubic feet. The exhausting of that 26,000,000 cubic feet would cost, I think, about £2000 a year—that is, the cost of coal and superintendence. I do not include anything for the interest on the cost of building, but am assuming that the outlay has taken place, and that I have only to provide for working expenses.

Sir J. SHELLEY: I suppose you think, in the event of its being successful, the matter of expense is not worth thinking about, the difficulties to which you have already alluded being got over?

Witness: Indeed I do not think it is worth it. I do not think it is worth £60,000 a year to ventilate the sewers of London by furnaces and shafts, supposing you could do it. I do not think the metropolis would gain that in an accession of comfort or of health. I should like to see the experiment made in some district or other before I pledged myself to any calculation of the expense. I have not examined into the experiments which have taken place in this House, and therefore do not know whether the effect has been to purify the air of the sewer as high up as Buckingham Palace. Supposing it were so, I should not think that that result alone would justify the trial of the experiment elsewhere. There are a great many other things to be taken into consideration. We want to know the number of collateral sewers coming into it before we could tell the value of the experiment. It would not be easy to ascertain that fact, for though the district board may have a map of the branch sewers, they would not show the house-drains—which are so perpetually altering, that, unless the board made it a matter of amusement to perfect their map, they could not tell. This is one of the main difficulties to be overcome. Another is, that unless you have a large number of shafts you will get such a large velocity in the main sewers that men could not work in them. You can get over that difficulty by having a ventilating shaft at the end of every sewer, and that would be a decided improvement if it could be carried out.

By Lord J. MANNERS: As to the cost, I should rather abstain from giving an opinion upon Mr. Gurney's plan of ventilation until fairly tested by experience. If you can overcome all the difficulties, then it is efficient no doubt. If the experiment had been tried in a sewer with all the usual conditions, and the results having been registered justified the conclusion that it was successful, there is an end of the objection. To the best of my belief no such experiment has been made. As to the physical possibility of doing it, expense being no object, it can be accomplished. I think the Victoria-Street sewer is one not under the ordinary conditions of a main sewer, because there are not a large number of collateral sewers running into it, nor a large number of house-drains. I have not personally inspected that sewer, but I do not think, if I had done so, I should have come to any other conclusion.

By Mr. LOCKE: There were frequent complaints before the gullies were made in the streets that the foul gases found their way into the houses of the inhabitants. By creating a great draught in the main sewers, I can conceive the possibility of the water in the syphons of the water-closets being sucked out. If all the mechanical arrangements were completed, regardless of expense, this plan would diminish the smells in the streets and the chance emanations from untrapped sewers in houses, because there would be a current downward; but with regard to the state of the Thames it would not have the remotest effect upon it. The state of the Thames is owing to the decomposition of what is in the river.

By Lord J. MANNERS: I do not understand this to be proposed by Mr. Gurney as a remedy for the state of the Thames.

Alderman CUBITT: Do you think the existing condition of the sewers is such as to call for any great alteration?

Witness: That seems to me to be asking whether I think the health of the inhabitants of the metropolis is so much damaged, or their comfort so much taken away by the present issue from the ventilating shafts, as to render it worth while to pay a large sum annually for the suppression of this nuisance. As to the first question, that is for medical men to decide; my view of it is, that it is not so injurious as to justify the outlay of £60,000 or £100,000 a year. It comes after all to a question of degree. There are many things upon which you would willingly spend a shilling, upon which you would not spend a pound.

Alderman CUBITT: Knowing, as you do, the public feeling upon the subject, and knowing what medical men have said upon it, what do you think?

Witness: I have read everything, I believe, in connexion with the subject which has been published during the last ten or fifteen years, and all the medical men have failed to convince me that the effects are so distinctly injurious that it would not be buying exemption from them at a very dear rate by paying £100,000 a year in carrying out this system.

Sir J. SHELLEY: To a certain extent, would not your answer apply to the river Thames?

Witness: Undoubtedly; but there is an entirely different state of things to be considered in reference to the Thames. The stink from the sewers is getting less, owing to the increased care bestowed upon them; but the river Thames, on the contrary, is getting worse, and must get worse and worse. I know, especially, in reference to the City sewers, that the effluvium from them is very greatly reduced, although the nose of the public has become much more refined than it used to be, and complaints are now made of things which formerly no notice was taken of. Bear in mind also that the Thames every year has conveyed into it the fœcal matter of 60,000 or 70,000 additional people, and that the supply of water in dry weather is greatly decreasing. From the better drainage of the upper parts of the metropolis, the rain-water is now run off in twenty-four hours which used to take a week.

The CHAIRMAN expressed his surprise that in the course of his inquiries witness had not examined the experiments carried on by Mr. Gurney in the House; and this led to some conversation, in the course of which it was suggested that an opportunity should be afforded him of so doing, and of reporting the result to the committee.

Witness said he could give no reason for not having made that examination, except that there was nothing in Mr. Gurney's report which appeared to him to make it necessary before coming to a conclusion upon the plan. Had he done so, he was not aware that he could have formed any opinion as to the efficiency of the furnaces, unless he had ascertained the situation and circumstance of every collateral sewer, their sectional area, the openings into them from house-drains, and every condition affecting the inlets.

The room was then cleared. On the doors being again opened,

Mr. *Maughan* produced samples of water condensed in 48 hours from the air in the upper part of the furnace, about two feet above, by means of a funnel, the top of which terminated in a vessel surrounded with ice. This water, he said, had no effect whatever upon the test-paper, nor was it affected by nitrate of silver, showing that the gases were entirely consumed, or, what was a better word, decomposed.

J. W. Bazalgette, Esq., examined by the CHAIRMAN.

I am the engineer to the Metropolitan Board of Works. For some years past the state of the Victoria sewer has come under my attention. I became cognizant of it shortly after its construction, about six years ago. I witnessed its completion, but did not examine it till afterwards. It was then in an imperfect state; there were numerous defects in it, which were the cause of my examining it. The sewer was constructed in a quicksand, and that sand escaped into the sewer, and caused a settlement both in the sewer and in the ground above it. I am now superintending its reconstruction, as, after reparation, it still continued to fall into decay. When I speak of the Victoria-Street sewer, I refer to the lower portion of it—the upper part, down

to Parliament Street, never having been repaired. The sewer commences at the upper end of Victoria Street, and comes down to the end of Great George Street, along Parliament Street, and in front of Richmond Terrace. Its course is then under the War Office, past the United Service Institution and the Office of Works, into Scotland Yard. There are not many sewers connected with it in its course, as compared with most main sewers. A general impression prevails that it is a very large sewer, draining a very large area; but that is not so. There is a record kept of all branch sewers going into it, but not of their connecting-drains. My impression is that, before ventilation by means of a furnace and shaft could affect the distant parts of the sewer, it would be necessary to make all the connexions near to the furnace tight, so as not to supply air; that is essential. I do not know anything of the state of the gases before and since the use of the furnace in this House. I have been through that sewer many times before and since, and never observed any difference; but have not examined it with that object. My impression is that, with all the other sewers passing into it, there would not be much difference in the higher parts of this sewer. I think the gases would only be affected in the immediate neighbourhood of the chimney, and that the supply of air passing through that chimney would be a supply from that immediate neighbourhood. I do not say that before you could form an opinion of burning the gases you must get the length and the breadth of all the sewers, and all their ramifications; I think you could form a very good general opinion from what we know of the ventilation of mines—what is effected, and at what cost. I devoted a great deal of time to the subject many years ago, in connexion with the Metropolitan Commission of Sewers; and the result of a long investigation was, that the system of ventilation by furnaces, as a general rule, was altogether impracticable, that its cost was very great, and that it was not necessary for the purpose. It was found to be impossible so to arrange the sewers as the channels of a mine are with a view to ventilation, and impossible so to trap them as to admit the flow of sewerage into them, and to take at the same time the air from the inlets to the furnaces. And if that furnace had to ventilate any large district, it would be required to produce so large a volume of air to keep up a velocity sufficient to ventilate all the branch sewers, that it would have the effect of opening any house-drain, or the most secure water-trap we could form. To put those difficulties, however, out of the question, though we considered them insuperable, it appeared to us that the cost of the coals required to be consumed in order to extract the quantity of air would be something enormous. Upon the assumption that no leakage from the drains took place, and that we had complete control over the whole of the channels, which should be so arranged as to admit of their being all filled from the branch drains, it would cost not less than £80,000 a year for working expenses. We made a calculation as to what the first outlay would be, but I forget the figures at the present moment. Those calculations were made by myself, assisted by officers of the commission, by order of the commissioners; and in the course of my investigations I went to Newcastle and to Wales, and examined into Mr. Gurney's system of a steam-jet, the system of furnaces, and by pumping. I have not seen the jet here, but I have read the result of the experiments made by Mr. Gurney in some mines worked by Mr. Nicholas Wood, in which he compares the system of ventilating by the steam-jet with the furnace, and goes into a very elaborate and detailed estimate upon the subject. The Victoria sewer is now in a very bad state as regards the brickwork, but that has nothing to do with the noxious smells in this neighbourhood. The sewerage at the present time flows down the Bridge-Street sewer, and it has done so on several previous occasions.

By Mr. STEPHENSON: That temporary diversion may, to some extent, have added to the nuisance, but I think the evil proceeds from a much more extensive cause. I conceive it is owing, in a great measure, to the dry state of the weather, the large body of sewerage poured into the river, and the state of the Thames generally.

By Mr. LOCKE: The total length of the Victoria sewer may be a mile, or something under, with about the ordinary number of openings into it for that extent. I do not think that in course of time that sewer would be extended, so that any experiment made upon it now might be considered a fair experiment in reference to what might be done in ventilating it. I have heard that by passing the air from this sewer mixed with steam through the fire it becomes inodorous, but I have not tested it myself. My own opinion is that, from the causes I have stated, any general system of ventilation of that kind would be a failure. I think that sewers can be much better rendered inoffensive by a copious supply of water than by burning the gases, or by any other process, as by that means the sewers are cleansed of all deposits, and are deodorized at the same time. I have no doubt such a supply as is necessary could be easily obtained. I have not directed my attention to the sources of supply, but they have increased,—and to that, to a large extent, the improved condition of the sewers is attributable; but the beneficial effects of that can never be felt fully as long as the sewers are stagnant for twelve hours a day. As long as they remain stagnant in a heated atmosphere gases are generated and sent off, and deposits take place. I do not think it is desirable that sewers should be entirely open. My view is, that they should be provided with a free outlet, so that instead of having the sewerage come down into a sewer the mouth of which is closed so that gases generate and solid matters are deposited, to be washed up again when the sewer is opened, if you can have sewers with a fair supply of water passing through them, and a free outlet so that the contents can pass away as rapidly as they are produced, you will have no smells at all.

By Mr. ROUPELL: As regards the number of inlets, the Victoria sewer is not analogous to other sewers in the denser populated parts of the metropolis. It is, therefore, more favourably circumstanced for the experiments by Mr. Gurney.

By Mr. TITE: I think there will be little complaint when sewers are built with more careful regard to levels, and there is a supply of water in them sufficient to keep them continually running.

By Alderman CUBITT: Some of the sewers are now stagnant for eighteen hours out of the twenty-four, and upon the average they are so for twelve hours.

By Mr. AKROYD: The ventilation of mines by furnaces is based on the principle that a certain quantity of air is required to feed that furnace, which air it is arranged should be drawn from the mine, and there is no difference in the application of the principle to a sewer; but in consequence of the difficulty of trapping all the openings into the main sewer, the draught of air may be drawn from a very narrow surface, and the system be ineffectual as far as the more distant parts of the sewer are concerned. I am not aware of the mode of ventilating lead mines by passing a swift current of water through them. I scarcely expect that passing such a current through a sewer would produce a system of ventilation; but coupled with deodorization I believe it would be sufficient.

By Mr. STEPHENSON: I am not aware whether I have been in the Victoria sewer while Mr. Gurney's operations have been going on. I have been in there frequently during the last two or three years, but have observed no difference in the velocity of the current of air. I never could tell whether Mr. Gurney's plan were in operation or not.

By Mr. PERCY: There are some hundreds of openings into the sewer, and I have found in some an inlet-draught, and in others an outlet.

By Lord PALMERSTON: I have never made any practical observations with a view to ascertain to what extent Mr. Gurney's plan of burning the gases in the sewers in the neighbourhood of this House has succeeded. My opinion as to whether or not the system could be usefully extended is founded upon an extensive inquiry in the mining districts, and applying the information so acquired to my knowledge of the state of the sewers of the metropolis. It is matter of observation also, as well as of inference, for I have tried the effect of a small furnace constructed with a shaft over a sewer, after trapping the communications for some distance down. I made one such experiment in Tottenham Court Road. It has been a subject taken up by every commission of sewers, and I have been on seven or eight. It has always been popular with a new commission, and all, after inquiry, have come to the same conclusion.

By Sir J. SHELLEY: The subject of Mr. Gurney's plan of ventilation going on in the sewer here, came before the Commissioners of Sewers three years ago, but I do not remember their decision upon it. I may say that Mr. Gurney proposed to them eight years ago to ventilate the sewers by the steam-jet, and he asked the commissioners to inquire into his experiments; but I do not recollect whether, in consequence, an examination was made of it.

Sir J. SHELLEY suggested that the witness should be requested to make himself acquainted with the experiments of Mr. Gurney, and to state to the committee at a future sitting what effect, in his opinion, those experiments have upon the atmosphere in the neighbourhood of the Houses of Parliament.

The CHAIRMAN inquired how long it would take to ascertain that?

Witness said he thought it could scarcely be done in time for the next meeting of the committee, as it would be necessary to ascertain, first, what currents existed in the sewer, and then what would be the current due to the steam-jet. He did not doubt for a moment that the steam-jet did produce a current which extended to some distance, but whether great or not, and whether obtained at any practical cost, he could not say.

After some conversation on this point, it was arranged that Mr. Haywood and Mr. Gurney should be associated with witness in the inquiry, and the committee then adjourned.

MONDAY, JULY 12.

Thomas Hawksley, Esq., examined by the CHAIRMAN.

I am a civil engineer, and have given considerable attention to the sewerage of London, and also to the state of the Thames as connected with it. I have made frequent experiments in the river. My observations began before the close of last year, and they have been continued by myself, with Mr. Bidder and Dr. Letheby, down to the end of last month. During the hot days, at the end of June and the beginning of July, I spent a great deal of time upon the Thames, and examined the condition of the river from Gravesend to Richmond, making observations, and Dr. Letheby at the same time taking samples of the water for the purpose of experiments in his laboratory. The general result of my observations is this: that in consequence of the very extraordinarily long dry period, there has been but a very small quantity of water coming down the Thames—so small, indeed, that at the termination of the Docks it was not more than about six or seven times the quantity of sewerage flowing into the river. The consequence was, that the sewerage accumulated to a very great extent, there was not a sufficient quantity of fresh water to oxidize it, and a very powerful stench, which was obviously the stench of sulphuretted hydrogen, arose upon the Thames. It is certain that it was sulphuretted hydrogen from the manner in which it blackened silver. No marks were obtained upon paper saturated with acetate of lead, but pure, bright silver put into the Thames was discoloured, and the odour of the water was decidedly that of sulphuretted hydrogen. I found when the Thames was in its worst state that the temperature was 72° a higher temperature than I had ever known it, or ever heard of its having been at. At that time the colour of the water was exceedingly dark from the general admixture of sewerage mud with it. The mud was in a decomposed state, and not confined to the shore as was mostly the case on former occasions,—this was quite an exceptional state of things, and it was uniform in the whole mass of water from side to side. The consequence was that the fœtor, particularly down at the lower end of the river, at low water, was beyond anything previously known. I ascertained how far the sewerage extended before it became deodorized, and the upper part of the river got back by the fresh water coming to it in a state of purity. I found that the sewerage extended from the upper part of Woolwich at the ebb to Chiswick on the slack at spring tides. At that time, of course, sewerage is carried down lower by the ebb and brought up higher by the flood than at any other period. On Sunday fortnight, which was one of the periods of spring tide, at about nine o'clock at night, off Woolwich, coming up from Gravesend, the scent of the odour just became perceptible. Below that point, notwithstanding there had been an immense accumulation of sewerage in the river for many months, it was completely deodorized. At Blackwall the odour was very distinct; off Greenwich it was exceedingly powerful—perfectly nauseous and sickening; off the Tunnel pier it became less distinct, though still foul; at London Bridge it was scarcely perceptible; at Waterloo Bridge it could not be perceived at all, nor at Hungerford. That was at the ebb, and the upland water was just sufficient to drive the sewerage down to London Bridge. On the contrary, at the flood the greatest intensity was perceived a little off the Houses of Parliament—the beginning being about Blackfriars Bridge, and extending up towards Chelsea. But the greatest intensity, as far as I could perceive, was above Waterloo Bridge. It began to diminish from Chelsea Hospital, and at Chiswick it entirely ceased; but I ascertained very clearly and distinctly that in this very exceptional period the sewerage water got up as high as Kew Bridge. Dr. Letheby, at the request of Mr. Bidder and myself, made a vast number of chemical analyses, and he has found that the sea-water now penetrates a very considerable distance up the river, and that the fœtor is principally owing to the decomposition of organic matters brought down by the sewerage and the sulphates of the sea-water. I have here Dr. Letheby's results in his own hand-writing, which are very valuable and very conclusive. The results of a number of experiments made on the 21st, 23rd, and 25th June, and occasionally on some other days, were these: that in the mid-stream at low water the total quantity of impurity in the river was 67 grains in a gallon off Greenwich; of that, the alkaline chlorides—consisting in chief of sea-water—were no less than 24 grains. On the same days at London Bridge in mid-stream the general total was 29 grains, of which 4 grains only were alkaline salts. At Blackfriars Bridge the total quantity was 27½ grains; at Hungerford, 28½; at Westminster, 26; at Chelsea, 29½, the alkaline chlorides being there only one grain.

Mr. TITE: By alkaline chlorides you mean those which are derived from sea-water?

Witness: There are some from land-water, but these were mainly those

from sea-water. At Isleworth the total quantity was 19½ grains, that being the usual quantity of impurities contained in Thames water in its normal condition. The alkaline chlorides were not observable there; but as at Chelsea there was only one grain, of course there would be none at Isleworth. These are the whole of the experiments taken at low water; but I have others taken at various places—one at Teddington Lock, one at Kew, and others at different points down to Vauxhall. At Teddington Lock the total amount of impurity was 19¼, at Kew Bridge 18½, at Hammersmith 19¾, at Wandsworth 21⅜, and at Vauxhall 29½ grains per gallon. The objects and the value of these observations are to show where the river begins to be impure at low water; and it is observable that at low water it begins to collect some slight impurities at Wandsworth, but not distinctly so until you get to Vauxhall. The impurity is divided into organic matter and mineral matter; and these are again subdivided into that which is dissolvable in the water and will not precipitate, and that which is suspended. There are 66 grains in the gallon at Greenwich, near the *Dreadnought*, at low water; of these 3·84 grains are organic matter in a dissolved state, and 2·57 in a suspended state. The mineral matter consisted of 48·96 grains dissolvable in water, and 11·42 suspended in the water.

Mr. TITE: Do you know the nature of it?

Witness: I have not got it here, but I can procure it from Dr. Letheby, and give it you. The largest portion of mineral matter was that derived from the sea, because it consisted of alkaline chlorides and also sulphuric acid.

The CHAIRMAN: Have you made any experiments as to the flowing up and down of the sewerage, and as to how long a time it takes to get to sea-water?

Witness: At the present time, or rather before the recent rains, the sewerage water was not proceeding down the river at the rate of more than a quarter of a mile in a tide; and the consequence was, that inasmuch as there was no possibility of deodorizing it by the introduction of fresh water, the Thames became indeed a sewer: it was the cistern of the London sewers.

The CHAIRMAN: Have you any idea, by experiments, from what distance down the river any sewerage ever comes back again?

Witness: In the worst period you are quite clear of it by the chemical action which takes place in the river below Woolwich—perfectly clear.

The CHAIRMAN: From your experiments are you satisfied that whatever sewerage passes Woolwich, none of it ever comes back again, so as to be decomposed and to be offensive?

Witness: Never in the state of sewerage, so as to become decomposed and offensive—it is completely deodorized.

The CHAIRMAN: After any of the London sewerage passes Woolwich it is there mixed with the water, and becomes so deodorized that nothing of any kind returns or deposits on the mud banks here, or is in the river here, so as to be offensive, according to your theory, at a high temperature?

Witness: My belief is there is nothing; that is the result of my observations. Now, with regard to the manner of coming back, I should like to be very clearly and distinctly understood, that the matter which flows into the Thames in some form or other comes partly back, no doubt, but not in a state of sewerage. The water must come back, for this reason—that you find the saline matters of the sea often up above London; and, inasmuch as that water can only come up by intermixture with the other water, anything which becomes intermixed with that must be brought back to the same point. Therefore I have no hesitation in saying that, if you put the sewerage into the Thames anywhere, a part of it will come back to London along with the salt water of the sea; but it will not be in a state of sewerage.

The CHAIRMAN: What I want to understand very clearly is this: that after the sewerage matter has got to Woolwich, that though portions of that matter must be returned, yet, after mixing with the water there, it will become innocuous, and do no damage to any part above?

Witness: Quite so; and the fœtor is only the result of the process of decomposition. The water in itself would not be fetid if not undergoing that process of decomposition by which it becomes putrid.

The CHAIRMAN: You have been examining the Thames year after year. We will omit from our consideration for a moment those very warm days when the water was in such a state of heat as to increase the nuisance; but, taking the times for the last few years, have you found the nuisance increasing or not?

Witness: Increasing.

The CHAIRMAN: To what do you attribute that?

Witness: There are several causes. In the first place, there is the improved drainage of lands in the valley of the Thames above the metropolis, which causes the water to be brought down after rains in a fetid state, and which also diminishes the quantity of water coming down in dry weather. That we find to be the case in all rivers and watercourses. We are now obliged to make them considerably larger than formerly, because the water runs off the land quicker, and in dry weather we are kept without water for a considerably longer period. The floods are also longer. That is one reason. Another reason, though not a very powerful one, is that there is an abstraction of water to the amount of about 40,000,000 gallons per day, which in dry weather is almost one-tenth or one-twelfth of the quantity which comes down. That operates to some extent. Then, inasmuch as a large quantity of water is taken out of the Thames in a pure state, a larger quantity comes in in an impure state. All these things acting together contribute to make the Thames really into a sewer; and, although the late extreme foul condition is an exception as regards the past, it will not be an exception as regards the future.

The CHAIRMAN: Of course you have come to the conclusion as to certain principles to guide any engineering operations with regard to the sewerage of London?

Witness: I know of nothing which (if the question be directed to the purification of the Thames) would effectually purify the river, except by removing the causes of the impurity, and preventing the sewerage going into the river at any point where it can become a nuisance to this large population.

The CHAIRMAN: You think there must be intercepting drains?

Witness: I believe there must be for that purpose; and I am quite sure, considering the manner in which the metropolis is extending, there must be for another and totally distinct purpose, and that is, to prevent the lower districts from being flooded by the great quantity of water suddenly sent down in storms, in consequence of the great extension of paved roads and improved water supply which is going on in the upper districts.

The CHAIRMAN: What principle would you think necessary?

Witness: The removal by intercepting sewers of the water of the upper districts, and preventing it coming down into the lower. Then, with regard to the purification of the Thames, and the relief of the lower districts, I would make a deep low-level sewer, from which the water should be raised by machinery for the purpose of preventing that water going into the Thames, and floods arising in those districts. The object of having several lines of sewers is this: in the first place, to be complete—for the great expense will be incurred in making the low-level sewers. The principal difficulties lie there, and the smaller it can be made the better. Then again, by taking off the water by means of the high-level sewer, a considerable amount of pumping will be saved, inasmuch as those sewers will be able to discharge at low-water mark. The low-level sewers, in consequence of the level upon which London is built, must be discharged by pumping.

The CHAIRMAN: I gather from your evidence that, as far as the Thames is concerned, you consider that it matters not whether the intercepting sewers go below Woolwich or not?

Witness: Quite so—care being taken to receive the sewerage into large reservoirs, so as not to be a nuisance until a proper period of the tide. What I believe, and what every person who has studied the subject admits, is, that the sewerage should be delivered into the river even at those low points just at the turn of the tide, so as to go out with the ebb, and not be liable to return with the flood.

The CHAIRMAN: Then, as far as the metropolis is concerned, you do not hold it to be necessary that the sewerage should be deodorized?

Witness: I think periods may possibly arise—very exceptional periods—in which, during the very hot months of the summer, it may be desirable to treat the sewerage in these reservoirs with lime before throwing it into the river. I am not quite sure that it will be necessary, except in the hottest periods of the year; but I think it possible that, in exceptional periods, it may be desirable. Those reservoirs are all that would be necessary for that purpose, because, as the sewerage must be raised from the low levels before being discharged into the Thames a few miles from those reservoirs, nothing can be easier than to put lime into the sewer at the point at which it is raised, and allow the milk of lime and the sewerage to travel together down the outfall culverts, and then discharge into the reservoirs. Precipitation will thus take place, and nothing but the pure, clear, supernatant water will flow off to be carried into the river; so that no nuisance can possibly arise to those persons who have rights of property upon the banks.

The CHAIRMAN: But from your experience you have never found the Thames in such a state as it is now?—and that, you say, is in consequence of the extreme heat of the weather. Even at that time you felt that if the sewerage could be got to Woolwich nothing would ever return to be a nuisance. I want to know, therefore, whether, if the outfall were below Woolwich, there would ever be any necessity for this deodorizing process?

Witness: I should be sorry to say that, even in exceptional cases, it would be necessary; but, inasmuch as for other purposes all the arrangements would be made, there is no reason why, in those exceptional periods, deodorization should not be effected. I have no hope of the deodorizing process in a commercial point of view, for, in truth, the sewerage is altered in its character—it is no longer a fertilizing agent when it arrives at the outfall; and that is the reason why all those failures have taken place. There is no difficulty in deodorizing, but there is a difficulty in rendering the sewerage valuable; because it is no longer what it was when it came to the sewer.

The CHAIRMAN: But you are aware that there are persons who say that it may be made so in certain conditions?

Witness: Well, considering that it contains no fertilizing matter, no ammonia-making substances after it has undergone those changes which are always taking place when it comes in contact with air and water, and most rapidly when in contact with water, it is, I believe, quite hopeless to expect it. It will not bear carriage. There is a little value in it, but not enough to make it bear the cost of three miles of carriage. The object I should have in deodorizing it would be not necessarily to pour it into the Thames without odour, but in such a state that further decomposition would not go on.

The CHAIRMAN: Do I understand you that when you have precipitated the sewerage by lime, nothing is left behind which can decompose or generate gases?

Witness: Yes, it would decompose. If there were a considerable quantity of dissolved organic matter not precipitated, and left exposed to the atmosphere without further dilution, it would be decomposed: but when a small quantity of fresh water is added, it ceases to decompose. That is the case at Leicester. There the quantity of sewerage dealt with is about 3,000,000 gallons per day; the quantity of water going down the river is about 9,000,000 gallons, being only three times, or rather, twice the quantity of sewerage, for the river itself is composed partly of sewerage matters. The deodorized water is perfectly scentless and perfectly tasteless, and, after being allowed to flow into the river and mix with twice its own bulk of other water, it never decomposes. The fish have returned, and the vegetation is clean, and certainly energetic.

The CHAIRMAN: I understand, as far as Leicester is concerned, the conditions are not the same as those of London; that there are very few water-closets, and that that which is the most offensive part does not exist. Is that the fact?

Witness: It is to a certain extent, but not to the extent which the form of your question would imply. There is a great amount of fœcal matter goes into the Leicester sewers which is dealt with at the deodorizing works successfully. The water is exceedingly offensive—it runs full of organic matter; but after leaving the works it is perfectly clear.

The CHAIRMAN: Am I right in supposing that the sewerage is of the worst kind, as far as sewerage goes?

Witness: I think in some cases there may be a larger proportion of it than in London, for though of course all the water-closets of London discharge into the sewers, the quantity of water delivered by the companies is so great that I do not know that the relative proportions are changed; indeed, looking at the analyses of Mr. Versmann, and comparing them with the analyses of Drs. Hoffman and Witt, I am inclined to think there is not much difference.

The CHAIRMAN: Then as I understand you, though the deodorized matter would generate gases, they would be in such small quantities that no damage could arise?

Witness: I think I may say I am perfectly certain upon that point.

The CHAIRMAN: Then comes the question as to the smell. Are you of opinion that if you treat it with lime the water will not disengage ammonia?

Witness: Ammonia itself is not offensive, but sulphuretted hydrogen is exceedingly offensive; but the lime prevents that smell. At Leicester there is not the smallest trace of it.

The CHAIRMAN: Can you explain this? We had two bottles of sewerage water left in this room for twenty-four hours. In one bottle some milk of lime was placed, and when we came the next day the water in that bottle was clear, and there was a deposit. In the other bottle the sewerage had deposited of its own accord, but the water was not so clear. The contents of the bottle in which the lime was placed were so offensive that you could not bear your nose to it; but in the other it was really almost inoffensive?

Witness: I cannot account for it; it is not according to my own experience. If the cork were left out there would be a considerable quantity of ammoniacal gas eliminated, which would be strong and disagreeable; but it is the same gas which proceeds from a lady's smelling bottle, and is perfectly harmless.

The CHAIRMAN: With regard to the intercepting sewerage—you would still have the river in a filthy state?

Witness: The river Thames will never be in a pure state. It would not give off those fetid odours which it does now, but it will be always dirty. In consequence of the removal of London Bridge, and the increase of the scour in the river, it always contains a certain quantity of sea-water, and of course a certain quantity of sulphates. Those sulphates will act upon the small quantity of organic matter brought from the upland district, and there will be a peculiar smell arising from the water; but it will be a totally different one, both in character and degree, to that which has been so offensive for the last few weeks.

The CHAIRMAN: That arises also from the mud banks?

Witness: I am not dealing with the mud banks, but no doubt, if they are allowed to continue, they will be always offensive, because there is a large quantity of organic matter already contained in them. I found a very excellent explanation of this the other day, in a work not much known at the present time, called "Acadian Geology," by a gentleman who was sent out at the instance of the Government to investigate the geology of Nova Scotia:—"The chemical composition of this singular soil, so unlike the red mud from which it is produced, involves some changes which are of interest both in agriculture and geology. The red marsh derives its colour from the peroxide of iron. In the grey or blue marsh, the iron exists in the state of a sulphuret, as may easily be proved by exposing a piece of it to a red heat, when a strong sulphurous odour is exhaled and the red colour is restored. The change is produced by the action of the animal and vegetable matters present in the mud. These in their decay have a strong affinity for oxygen, by virtue of which they decompose the sulphuric acid present in sea-water in the forms of sulphate of magnesia and sulphate of lime. The sulphur thus liberated enters into combination with hydrogen, obtained from the organic matter or from water, and the product is sulphuretted hydrogen, the gas which gives to the mud its unpleasant smell. This gas dissolved in the water which permeates the mud, enters into combination with the oxide of iron, producing a sulphuret of iron, which, with the remains of the organic matter, serves to colour the marsh blue or grey."

The CHAIRMAN: As I understand you, do what we will, we must be prepared, should the mud banks remain, to have a certain odour given out which will be unwholesome?

Witness: Yes; the odour will be unwholesome. I think the mud banks ought to be abolished by the substitution of broad terraces and vertical walls, so as to make an embankment on both sides. The river should be trained between them, and the walls going down not less than 7 or 8 feet below low water. The evils now complained of would then be wonderfully mitigated. The mud banks contribute very considerably to the existing nuisance by the continual deposition of sewerage matter upon them, for, though constantly washed off, there is always a thin film left by the water, which, being exposed to the sun, gives out a large quantity of sulphuretted hydrogen. If there were intercepting sewers there would still be small quantities of sewerage matter in the river, which could not be dealt with by interception—in the neighbourhood of the Docks for instance, where, in consequence of the dock entrances coming into the river, it would be quite impossible to get a sewer. So in the Isle of Dogs, it would still be necessary to allow the sewerage to go into the river; but, inasmuch as by going into so large a body of water it would be effectually deodorized, so as to be no nuisance whatever, I should be quite ready to recommend that the sewerage of that and other places, such as Richmond and Brentford, and even Wandsworth, should be put into the river, but in a deodorized state, in hot weather. There is also the question of the western district of London, which is very thinly inhabited, and which it is almost impossible to deal with by interception.

The CHAIRMAN: With regard to the shipping?

Witness: The quantity of sewerage from that source is perfectly insignificant.

By Mr. ROUPELL: The fresh water is not diminished in quantity; it is rather increased, but is very altered as to the way in which it flows. Inasmuch as it flows in very rapidly now, there is no loss by evaporation. In the summer, no doubt, the bed of the Thames is diminished; it must follow the law which operates in smaller rivers, which we have the opportunity of gauging. We know that in dry weather much less water comes down now than formerly, owing to the increase of drainage works in the agricultural districts. The admission of brackish water intensifies the decomposition, and causes it to go on more rapidly. The sea-water hastens decomposition, and in the same way it hastens deodorization, and in that way gives off a proportionate amount of smell at the time. In some cases the emptying of cesspools into the Thames at the present time may increase the nuisance, but practically I think it has very little effect. In a lake where there is only the ordinary amount of vegetable matter, when the water recedes from the banks there is always an offensive exhalation, and agues and many fevers are produced from the mixture of organic matters with sea-water. The fevers of New Orleans are distinctly traceable to this cause. On the coast of Sierra Leone there is another cause in operation, and which was written upon by Professor Daniel some years ago. There he found that the water brought down considerable quantities of organic and vegetable matter, which decomposed the sulphates contained in the sea-water. The offensive exhalations were very marked, and also the fevers resulting from them. The mud banks of the Thames must be obliterated either by putting a dam across the river in order to cover them with water—which dam would interfere so materially with commerce that, in a public point of view, it would be impracticable—or by an embankment, which is practicable. It is, roughly speaking, about forty miles to the Nore, and if the sewerage waters never went faster than they do now, and never became intermixed, it would take half a year for them to reach that point. It goes at less than half a mile at this period of the year, but the sewerage never goes to the sea in a mass; it is always mixed with tidal water, and goes much faster when below London than would be represented by its volume.

Mr. ROUPELL: Do you think the sewerage of the metropolis is tossing about in the Thames for a couple of months before it gets to sea?

Witness: Yes; in the sense in which the question is put it must be so, but with the admixture it is not so. I will suppose that, instead of sewerage, a certain quantity of something that may be perceived—say sugar, which may be perceived by the taste—is put into the river. If the sweetened water did not become intermixed with the unsweetened water, it would be found occupying a certain part of the river, and travelling down at the rate of a quarter of a mile a day; but, inasmuch as at the place of contact the waters became rapidly mixed, some would be found two or three miles down, and some two or three miles up the river. There are two methods of deodorization: one by putrefaction, and the other by combustion. When there is a quantity of anything, whether air or water, containing oxygen in sufficient quantity, combustion will take place; and in that case there is complete deodorization without the giving off of the offensive gases. On the other hand, if deodorization takes place, as it has been in the Thames, by putrefaction, then gases are given off, and very offensive smells are exhaled. By putting the sewerage from the reservoirs into the river, where the water is fresh from the sea, and going back to the sea, I believe it will be completely deodorized. At the present time the operation of deodorizing is going on in the Thames. There are 700,000 people living above London, the sewerage of which population goes into the river; and yet the Thames there contains no perceptible quantity of sewerage matter, there being less than two grains of vegetable and animal matter in a gallon of the water. I am one of the engineers appointed to examine the plan of the Metropolitan Board of Works. We propose not to allow the waters of the western district to go into the river in their present state, except when they are very small in quantity. We prefer to deodorize them; at the same time we propose as an alternative, if the Thames embankment is constructed, that the sewerage of that district should be pumped into the low-level sewer and carried down to Barking Creek.

Some questions were proposed by Mr. Roupell on the engineering points of the referees' plan, which were objected to and withdrawn.

In answer to further questions by the honourable member, *Witness* said: In reference to the deodorizing of the sewerage in the metropolis, we made very minute investigations, and we came unanimously to the conclusion that it could be done no nearer than Barking Creek on the one side, and Crossness point on the other. What with the Docks, &c., I believe no nearer station would be available; or if there were, it must be upon the river Lea, three or four miles from its mouth, and that would not be a proper stream for the purpose. If we could find such a station I should not object to erect works there; I do not think any offensive exhalations would be evolved in the process. We made minute examination of the question at Leicester, and Dr. Letheby caught the gas as it rose from the tanks. It consisted of light carburetted and hydrogen gas, and contained not a portion of sulphuret. I believe the operation can be carried on without injury to the health of the inhabitants.

By Mr. TITE: It is my opinion that the deodorization of the great mass of the sewerage of the metropolis would not be necessary at all times. The circumstances which might give rise to that necessity would be a very high temperature of the river, and a very small quantity of upland water coming down. Short of that, I am very confident the sewerage might be poured into the river—not as a matter of opinion, but a matter of theory. I am acquainted with other substances used for deodorization besides lime. I know and have practised it with sulphurous acid, though not for the purpose of deodorizing sewerage water. The result was complete deodorization; but it is neither economical, nor is it free from certain serious objections. For instance, if sulphurous acid is used in a sewer, and any of it escapes and gets into a house, which it is very liable to do, it is so exceedingly irritating to the lungs that it could not be tolerated. I have not made experiments with the sulphate of alumina in the form of an artificial sulphate. We use burnt clay frequently. For instance, at Rugby I have used it in combination with ashes, and there it certainly does produce some effect in deodorizing, but it is not perfect. The object is to arrest putrefaction and to prevent the ammonia flying off. At Rugby the object was so to arrest the vegetable matters that nothing should be found floating in the river, and should not accumulate in the mill-ponds, which were fed by the river; and, as far as I know, all the parties in the form of complainants are satisfied. The medium employed was this:—The lower stratum was a stratum of burnt clay; next, a stratum of town ashes from which the fine matter was sifted—carbonaceous matter, in fact. This is not simply filtration; a small chemical effect is produced by the ashes and the clay, similar to that produced by charcoal, though not, of course, so powerful. The burnt clay which contains the peroxide of iron also produced an effect. The sewerage matter there is, in the first instance, pumped on the land by machinery; but they find they cannot use the whole of it in that way, and the remainder of it goes into the river. This produced a decided foulness, and complaints were made. I was applied to for a remedy, and I recommended this process. There is a Local Board of Health at Rugby, and they entered into a contract with a gentleman named Walker, who thought the liquid sewerage would be very valuable as a fertilizing agent if placed upon the land. It has not, however, turned out so; and, consequently, he is not disposed to go to the expense of taking the whole, and some portions flow away. All the tanks are so arranged as to admit of the sewerage, if necessary, being precipitated by means of lime; but as the deposit is not valuable for commercial purposes, it is not adopted. In the river it has now become so far innocuous as not to produce any ill smells; but it has not been in use long, and therefore it is not desirable I should express a very strong opinion upon it. I believe in all respects the experiment at Rugby has been a failure. I am informed by the tenant, Mr. Congreve, who applies the water largely on his land, and is bound to do so by the terms of his lease, that he finds the additional produce is just about sufficient to cover the expense, and nothing gained; that it is not valuable for cereals at all, but does very well for grass land, provided there is under-drainage. At Rugby the land, which amounts to about 470 acres, has about five miles of pipes laid into it. To those pipes ordinary movable hose-pipes are attached at intervals. The water is pumped through the main pipes by means of a steam-engine, and is distributed by a number of old men and boys, at low wages, upon the grass land.

Mr. TITE: You have been asked some questions with regard to deodorizing stations nearer to London than those you have suggested, and the question I want to ask is this,—whether you can see any system or scheme upon which the water in the great sewers can be deodorized in its course, or at the mouth of the sewers, so as to ensure its being pure before it enters the Thames. But, first, with regard to the deodorization of the water in the sewer in its course, do you imagine it can be done practically?

Witness: No, I think not—with due regard to expense.

Mr. TITE: Can it be deodorized by the side, at or near the mouths, supposing sites could be obtained near the large sewers?

Witness: The operation, with some difficulty and except at some exceptional periods, could, no doubt, be performed, but the result would not be satisfactory, inasmuch as a large amount of deposit would be occasioned, which it has been proposed should be pumped away; but that deposit does not admit of being pumped away, though diluted with fifty times its volume of water. It will flow, no doubt, in a pipe, but the moment the machine was stopped precipitation would take place, and that precipitation will accumulate in the pipes till they will become stopped up. It is not practicable, I am satisfied from my knowledge of a similar process, to pump that material continuously in long pipes, even if a place could be found to receive it.

Mr. TITE: Is it possible to convey it away in barges?

Witness: Yes. The operation would have to be performed in this way:—In the first place these establishments must be rather numerous upon both banks of the river. At the mouth of each there must be a capacious tank, sufficiently large to admit of deodorization being successfully practised under all circumstances. A steam-engine must be erected for the purpose of pumping the water into these tanks and out of the sewers (because many of them are below low-water mark), in order to keep the sewers empty, because the great object of the tunnel sewers is to prevent the water accumulating in the sewers. Other steam-engines must be erected to pump the water into the

country, and others (or the same might be employed) to lift the slush into the barges. This plan could be managed in an embankment, so far as receiving-tanks are concerned; but you cannot put a steam-engine there, because, if the embankment is to be useful and ornamental, you cannot raise it more than four feet above Trinity high-water mark. At the first glance it appears to me that it would be much more expensive to convey the material away in barges than the system of interception which we have suggested, and it would be much less effective. I cannot conceive such a plan as this applied to the Fleet sewer, for instance—there is no site there; nor to the London Bridge sewer. In fact, the plan would not effect many of the objects intended to be obtained by interception.

Mr. TITE: The suggestion has been made to deodorize the Thames water on the river itself in large cassoons—is that practicable?

Witness: I think not. I think vessels of that kind could not practically be made. The ordinary sewerage, without the rainfall, amounts to 80,000,000 gallons per diem, and the number and size of the vessels to receive that amount of sewerage would be something enormous. It would be the largest fleet of vessels ever seen in the Thames.

Mr. TITE: You say that no scheme, in your judgment, would be complete unless the river were embanked?

Witness: I think the river ought to be trained between walls, so that no part of its bed should become exposed, even at low water in neap tides. My idea involves the total filling up of the intervening space. It has been proposed that certain docks should be constructed within the embankment. I should have a very great objection to impounding Thames water in a stagnant state behind an embankment, and I think it would not be calculated to make the embankment answer all the purposes to which it might be applied—such as the opening out of wide roads, affording means for recreation, a line of railway, and several other useful objects. There would be no obstruction to wharfage or business, and, for landing purposes, cranage could be employed. I think, to a certain extent, it is desirable to have lay-byes for vessels, but I think also that it could be better managed for vessels to lie in the water, and be discharged by cranes into warehouses. No doubt it is very convenient for persons to crane into warehouses at first, instead of from a wharf wall; but I apprehend there need be no difficulty about it. I would have the cranes immediately opposite to the warehouses; they might be hydraulic or otherwise, and goods might be lifted out of the vessels, and run along small tramways. I do not mean to say that in no case would there be inconvenience, but I am quite satisfied the general inconvenience would not be considerable, while, in many cases, it would be a positive advantage. I have not consulted wharfingers on the subject, but I think it quite possible they would be against the plan. There would be no difficulty with coal barges; they would lie alongside the wall always afloat, and the coals could be whipped up exactly in the same manner as from ships. There is less difficulty with coals than with anything else. Some inconvenience might arise, and some compensation might be required. If the only object of the embankment had been to prevent the deposit of mud after the sewerage was separated, we should not have advised it. The other object is to enable a main sewer to be made to receive the water of the lower level without passing through the dense and crowded streets of London, and under the most important buildings in the City.

Mr. TITE: Could not that be done without—say, by an iron sewer along low-water mark?

Witness: I am able to say confidently that an iron sewer is almost impracticable. An iron tube bears pressure from within without difficulty, but it does not bear external pressure without liability to fracture. I have had large iron tubes that would bear 300 feet pressure from within, but which broke with only 16 feet of earth upon them. A tube with a semicircular bottom and flat top, as proposed, would require to be made of immense strength, because it must be placed below the level of low water, and would have an hydraulic pressure above of 25 feet—that is eight pounds upon the square inch. The external pressure would not arise from the water, but from the material in which the tube would be embedded. Of course, I contemplate that in any case the sewer, whether of masonry or of iron, would be placed in a nearly water-tight embankment, necessarily; and if so, there would be an irregularity of pressure upon the tube which I have no doubt would lead to fracture. I do not say that a flat tube would inevitably collapse, because engineers can make them of any strength; but I think practically it would not be done.

In answer to further questions by Mr. TITE, witness said: At the present time the sewerage of the metropolis does return, but below Woolwich the water is deodorized, and it is not injurious. The plan suggested is to receive the sewerage matter into large reservoirs at Barking Creek and Crossness Point, and to discharge it into the river at high water; and though it would oscillate with the tide, it would never practically come higher than the point of discharge. The water that now comes over Teddington Lock is about six or seven times the amount of the sewerage of London; the water that is abstracted by the water companies above the Lock is rather less than 40,000,000 gallons per day. The rest of the water supplied to the metropolis is obtained from the Lea and the Ravensbourne. It may be all said to be derived from the Thames, because the water of the Lea assists in deodorizing the sewerage water as it comes up to London. The navigation of the Thames would not suffer in any perceptible degree by intercepting the sewerage waters and turning them all into the river at Barking, because, as it is a tidal estuary, if you were to divert the whole of the water from above the level of the stream immediately opposite the Houses of Parliament, it would be within a fraction what it now is—the only difference being that it would be salt water instead of fresh. I have not seen the deodorizing works at Tottenham recently—not since they have been altered. The sewerage there is deodorized before it enters the Lea, and it is generally pretty well done; but the circumstances are not similar to those which occur in other places. A large quantity of fœcal matter comes down there in a solid form, and is caught and made into a fertilizing manure without undergoing the process of deodorization by interception. Ashes are not used there to any great extent.

By Alderman CUBITT: The quantity of sewerage matter is very nearly 80,000,000 gallons per day. There is, of course, a considerable quantity of water raised from wells by brewers and others in addition to the quantity supplied by the water companies, but there is also a considerable loss by evaporation and otherwise in the total supply distributed amongst the population. The water supply and the sewerage matter so nearly balance each other, as far as we can make out, that you may consider that there is 80,000,000 gallons coming in and 80,000,000 gallons going out daily. In addition to the loss by evaporation, there is loss by road watering and washing. I should think there is a loss of from 20 to 30 per cent. There is something due to rivulets coming down from the country, but we should intercept very few rivulets indeed. The Fleet would be intercepted. Counter's Creek cannot now be said to be a rivulet. It collects a certain quantity of rain, but that is so mixed up with sewerage that it can scarcely be called anything else but a sewer. There is no difference in the actual quantity of water in the Thames between the Houses of Parliament and Richmond since the water companies have drawn their supply higher up, but there is a difference in the quality. The sewerage and the salt water now go up. I often hear complaints of a want of water, but the best proof that this is a mere prejudice, is to be found in the fact that there is no perceptible difference in the level of high water. When the tide has run out there is a slight difference, but only a slight one, because the quantity running out at low water is so enormous that the quantity abstracted by the water companies is very little as respects level. It affects velocity rather than level. At low water at spring tides there is minutely less water now than there was before the companies were established.

Alderman CUBITT: Supposing a column of sewerage water ten feet high were still for an hour, what thickness of deposit would be at the bottom of it?

Witness: I cannot give it you in thickness, but I can give it you in weight. There would be about 70 grains per superficial foot. Ten feet is, of course, 120 inches. The quantity of sewerage matter is about a 700th part, and that would give about one-sixth of an inch in depth.

Alderman CUBITT: That is after being dried and hardened. I want it merely after having been at rest for an hour.

Witness: I cannot give it in that form.

Alderman CUBITT: You are aware that it is on account of the great difficulties in the way that the Thames embankment has not been carried out. Supposing those difficulties still to exist, and that we are not to have that scheme adopted, do you think it possible to prevent the mud accumulating on the shores of the river by some kind of slope or other?

Witness: Not as respects the mud which is mixed with alluvial matter. With respect to the sewerage mud which Mr. Gurney specially refers to, I believe it can be done. It is very light, and it will ripple down like light soil, and will not require a very large incline. But this is not the mud which Mr. Bidder, who has been associated with me, answered to on a former occasion. He answered with respect to the mud which consists of alluvial matter brought down by the Thames mixed with a certain quantity of organic matter. That mud will become fixed, and there is a large quantity of it now lying under the shingle opposite to this House. There is a mud bank with shingle on it, below the bridge, of 4 feet deep.

By Mr. AKROYD: The solid matter in the sewerage running down is about a 700th part of the quantity, or about 500 tons daily. I think I have heard it differently stated, but it is from 300 to 500 tons. There would be no physical difficulty in taking that quantity away in barges; but if by some simple mode it were possible to keep back all the solid matters at the mouths of the sewers, you could not by that mere filtration send the water in a limpid state into the Thames. Lime acts upon sewerage water both mechanically and chemically. The quantity of sewerage deodorized at Leicester is about 3,000,000 gallons daily. For this purpose there are two tanks, used alternately, of 1000 square yards each. It would be difficult, but not impossible, to erect such apparatus at the mouths of the London sewers. At present some of those sewers discharge at all periods of the tide, many at half tide, and many more not till low water. The sewers will discharge whenever the level of the water in them is above the level of the water in the river. It is not of the slightest consequence to return all the water which is taken out of the Thames. The abstraction of it has no effect either upon the scour or the navigation, because whatever is taken away is immediately replaced by the tidal wave.

Mr. AKROYD: But assuming a certain depth of low water now, say 10 feet, if you take 10 feet of water from the river, you do, *pro tanto*, reduce that level?

Witness: You are referring to the upland water, where there is no tide. There will be an alteration in the sectional area of the river, and in its velocity; but the level will be altered not a tenth of a foot, but the fraction of a tenth. I am aware that, in the north, when water companies take water from a stream they are compelled to provide compensating reservoirs, and if they could be established in connexion with the Thames there would be a larger amount of scouring power at low water. But it is impossible to get any area of land sufficiently capacious to hold the quantity required, and I should not recommend it because there really is no deficiency of scouring power at present. The real difficulty arises from the water not going down to sea, but flowing backwards and forwards. There is a great amount of scour; so much so, that since the removal of London Bridge the river is deeper by four feet. If the discharge of sewerage is at Barking Creek it will be discharged into a much larger section of water and at a period of time when it must go seaward instead of towards the metropolis. Then, too, going down in that large volume it will get so mixed up and so decomposed, that when it does come back again, even in small portions, it comes in a very different state.

Mr. AKROYD: You told us that a small quantity of sea-water aggravated the evil. Then, inasmuch as there is more salt water at Barking Creek or Woolwich, if you pour out the sewerage in the same condition there, you will have a greater nuisance?

Witness: If you did it under the same conditions it would be intolerable. Here the sewerage is discharged at low water, when the volume of the river is very small; there it will be discharged at high tide, and when the volume of water is at its maximum. Under ordinary circumstances the sewerage itself would not be altered in condition; but the difference is very great between discharging into a small volume here or a large one there—so much so, indeed, that when the amount of sewerage matter in London was much smaller than now, and in proportion to the quantity of water in the Thames, that water was fit for drinking. It was pumped for 40 years at Lambeth and 20 years at Chelsea, and the same period at the Southwark and Vauxhall Works. The water was then good, but now it is intolerably bad. There is undoubtedly more sea-water at Barking; but it would have the less effect, as the volume of the river is so much greater, and the decomposition, when merely by mechanical process, gives out no offensive gases.

Mr. AKROYD: How would you ventilate the large sewer you refer to? The present condition of the sewers is that at every gully-hole the air is improved. But if you keep the sewerage matter penned up to Barking Creek, the fermentation which will take place will be something fearful.

Witness: No; the best condition of a sewer would be that of a perfectly closed pipe. There are, however, certain reasons why, in ordinary sewers, we do not make it so, arising from the bringing in of drains from neighbouring houses. But this sewer will have no drains in it. There is scarcely any difficulty with regard to the gases generated by sewerage matter, which in sewers are very small indeed. Ordinary sewers are inclined, and it is necessary that they should have a communication with the atmosphere, in order that they may have the same barometric pressure in the sewer as out of it, for if it were not so the foul gases would get into the houses. Indeed, that frequently does happen, and causes most abominable smells in kitchens.

Mr. AKROYD: I will not ask you further. The honourable member next me (Alderman Cubitt) says that fermentation ceases when you exclude the air.

By Sir B. HALL: The committee are to understand that I have come to

these two conclusions:—First, that it is desirable—in fact, absolutely necessary—to have intercepting sewers to carry off the sewerage of the metropolis; and, next, that it would be advisable, in order to render that work complete, to have an embankment of the Thames. I should think it advisable, but not absolutely necessary, that those two works should be carried out simultaneously, and the one made in connexion with the other; because if intercepting sewers were made upon both sides of the river, and the low-level sewer were not made, the quantity of sewerage matter flowing into the Thames would be comparatively so small that, practically, it would bring the river back to what it was fifteen or twenty years ago. The low-level sewer should, then, be constructed in connexion with the embankment. The area of the metropolis to be drained by the high-level sewers is less than thirty miles—I think about ten miles by the upper and seventeen or eighteen by the middle level. The area left undrained would not be so large, but more densely populated. It is my decided opinion that all the sewers should be carried out simultaneously. If the embankment is not made, the low-level sewer will practically drain the same area; but a considerable number of sewers would have to be reversed in their fall from the Thames, instead of maintaining their present fall. In carrying out the low-level sewer without the embankment very considerable difficulties would arise on the north side in a structural point of view. On the south side there would be very few. On the north side a large new sewer made through the most important part of London would have to be made at a great depth, and it would be impossible in all cases to answer for the safety of buildings in the line of its course. On the south side the land is perfectly flat, and the sewers are laid practically without any fall. All that is wanted there is to collect them together, so as to have a common outfall at Deptford Creek, where the waters would be lifted.

By Mr. PERCY: The difficulties in reference to landing goods if there were an embankment would not be very great. The same thing exists in many large towns. For instance, at Newcastle the warehouses are not immediately overhanging the river, and the goods have to be taken out of the vessels sometimes by cranage and at others by whipping. It is the same at Liverpool, and indeed in more cases than the contrary mode. I should not be doing the subject quite justice if I did not mention that the number of wharves above London Bridge are not so numerous as below, and the question is not a very serious one even if it involves compensation. The floods in the river do not do much mischief, but the extraordinary high tides sometimes do. There would be no danger of increasing that mischief by an embankment, as it would be four feet above Trinity high-water mark, the highest point to which those tides ever rise. It is not proposed to carry the embankment below the Tower; it is desirable to do it to that distance, as it would give a very good quay for sea-going vessels. The analysis of the water below Woolwich made by Dr. Letheby was on water taken from the surface, but in the tide way, and where it is thoroughly mixed.

By Lord PALMERSTON: The balance of the descent of sewerage matter over the ascent amounts to half a mile in two tides, so that sewerage discharged here in London would be, at the end of twenty-four hours, half a mile below, except in so far as it is affected by the state of the moon. When the tides are growing it may not be so, but, taking the whole of the lunation, that is the effect.

Lord PALMERSTON: How many days' sewerage should you think are floating between London Bridge and this part of the river?

Witness: I have not calculated that, but I can supply the information. There are many, very many days. That quantity is always in certain states of the atmosphere decomposing and emitting noxious gases. When the temperature is low it is not perceived; when it is high it is very considerable. When the temperature is below the mean—that is, below 55°—or in winter, I do not think it produces any bad effect, nor is there any effluvia from that which is left on the beach and becomes dry at low water, except it comes a very sunny day. The sun of winter is almost as hot as that of summer in its direct rays, and if that falls upon the mud there is a stench from it, but so slight as not to have any effect upon health.

Lord PALMERSTON: Your plan is to divert the whole of the sewerage to a lower part of the river by tunnels, and you stated that iron tunnels would be liable to fracture by the pressure of the superincumbent weight.

Witness: That is the case, unless they are made enormously strong at a great expense. It would depend, to some extent, upon the depth at which they were placed below the surface of the soil, but if they were of large diameter, not to any considerable extent. It is surprising how soon a cast-iron construction alters its form, and, being a very brittle material, it is very liable to break. The pressure above would not be at all analogous to the pressure below in the Menai Bridge. The iron at the bottom of the tunnel would not be liable to be affected materially by the action of the sewerage water upon it, or the friction of extraneous substances getting into the sewer. Sewerage water is generally alkaline. I recollect a case which occurred in 1830 of a large water-pipe being carried through a sewer. I was anxious about the pressure upon it, and also the effect of the sewerage, but I found that no chemical action took place at all. I think the detritus washed from the streets by storm-waters would have no other effect than to brighten the bottom of such a tube. The sewerage, when it arrives at the end of the intercepting sewers, will be deprived of all its fertilizing properties, the water producing a very specific action upon the elements of which it is composed. They become decomposed, and are recomposed into other forms, which do not possess any fertilizing properties. They undergo a chemical change—a very perceptible one, and one that is now thoroughly understood. At Rugby the sewerage distributed on the land certainly improves the grass, but, as I said before, the case of Rugby is exceptional. There the substratum of the grass-land is so perfectly open, that the sewerage will disappear, though put upon it in large quantities, in the course of ten minutes or a quarter of an hour. It is rocky ground, and very open below; but where sewerage is put upon land which is not of that character it will not produce such an effect. Where it has been applied to strong land for the purpose of producing corn crops, it has, to a great extent, failed. It is best for green crops, including grass, and for this purpose it has answered in the neighbourhood of Edinburgh. I am very well acquainted with the Craigentinney Meadows, where the sewerage water is admitted in considerable quantities. The grass there is cut, perhaps, once a fortnight, and it is in a very sapid state, and will not keep at all. It would not do at all to make it into hay, as it would be sour in 24 hours. It is carted into the town, and is immediately eaten. Under those circumstances, no doubt land may be made to produce very valuable crops, but if the sewerage water had to be conveyed five or six miles from the town, it would be of no use. Those meadows let for very high rents, but that is not in consequence of the sewerage, but chiefly by reason of the proximity of the land to the metropolis. I do not think the sewerage of London would be applicable for any purpose beyond raising low land in marshes.

By Mr. STEPHENSON: The present state of the Thames is attributable in great measure to the sewerage poured into it from the metropolis. With Mr. Bidder and Mr. Bazalgette I have come to the conclusion that interception is the only feasible way in which it can be remedied. If the Thames as it passes through London were ten times its present size the sewerage matter might be discharged into it at once and no one would know it. At present the contents of the high-level sewers find their way to the Thames through those of the low level, which, though they might have been adequate at one time, are completely overcharged now; and, as a general rule, many of those sewers only discharge for half of the twenty-four hours, and some less. The area of the southern portion of London, which is not drained more than eight hours a day, is more than twelve square miles. The cost of the removal of the sewerage matter, supposing the deodorizing process took place in London, would be more than equivalent to the interest of the money spent upon intercepting sewers; because, even if that were done, certain intercepting sewers, and those of a very expensive class, are absolutely necessary to be constructed. On the north side of London, extending towards Hampstead and going out towards Acton, the state of the drainage is such as to render some other mode for taking the water off than now exists most essential. If the high and middle-level sewers were executed it would mitigate the present evils very materially. The Thames embankment is by no means absolutely required in constructing the low-level sewer, but it would afford an easy mode of carrying it out and intercepting the lowest levels. From that sewer the refuse would be pumped up to the high level and carried to Barking; and I ought to mention that the works are so arranged that at any future time they can be extended, even to the sea. Not that any such necessity is likely to arise; but, should it be necessary, all the works at Barking Creek and Crossness Point will be available, and the culvert may be continued down to the Nore.

By Sir J. SHELLEY: I do not know of any spot in the metropolis which would be eligible for deodorizing works. At Rugby the material deposited is not sold; it all belongs to Mr. Walker, who leases it, but unfortunately is not able to use the whole.

By Lord J. MANNERS: I arrive at the conclusion that the sewerage discharged into the Thames below Woolwich at high water would not return in an offensive state by practical observations, and as the result of float experiments; for although float experiments are very imperfect, they do tend to the conclusion I have had the honour to announce. If the water goes in near the top of the tide it cannot rise higher than the place at which it is discharged, nor so high as the quantity of the upland water will descend. The water discharged on the top of the tide will go with the ebb a certain number of miles to sea. Then on the flow it will come up a certain number of miles, not quite so high; the next time a little lower, and so on going backwards and forwards until it reaches the sea. If, on the other hand, it was discharged on the flood, the water would immediately travel up towards the metropolis, still getting to the sea in time, but in its course coming up to London. It is a fact that whatever does go in at Woolwich in that way always comes back perfectly deodorized. The whole river between here and the sea is mingled with sewerage which has been going in for hundreds of years; and yet at a certain point it became so completely deodorized that it is not only unobservable, but perfectly innocuous. That point now is the upper end of Woolwich, and there you may see as distinctly as possible that the water is perfectly inoffensive even at low tide. In making our calculations we have taken into consideration the gradually-increasing volume of sewerage matter discharged at one time at the same point. We propose to discharge it at a number of mouths into very deep water, where there should be at the time of discharge not less than 20 or 30 feet of river-water above it. Discharging at the ebb, the water will not flow up Barking Creek.

Lord J. MANNERS: Has not the great part of the sewerage now in the Thames been discharged at different points, and therefore been undergoing the process of decomposition in a way which will not take place if the whole mass is discharged at one moment?

Witness: That is so; but then we discharge it equivalently into a much larger body of water. The sectional area of the Thames there, is enormous as compared with the sectional area in London, and the sewerage will be deodorized in a much shorter period of time.

By the CHAIRMAN: I am not an advocate of deodorization other than under exceptional circumstances. That such circumstances may arise we have evidence in the river at present. If the necessity arose for it we should be prepared to do it without any extra expense for works, except a steam-engine, the material, the wages of the people employed, and the taking away of the slush. It would take some years to complete any general plan of intercepting sewerage, but relief might be obtained in a very short time, perhaps in twelve months; in eighteen months certainly, on both sides of the river.

The CHAIRMAN: In the mean time, what palliative would you attempt?

Witness: I would simply recommend the deodorizing of the sewers with lime during the hot weather, and, anticipating an event of this kind rather than waiting till it occurred, I would commence in May and keep on till October.

The CHAIRMAN: Do you think that for some years you might continue to pour in this milk of lime without injury to the sewers?

Witness: There would be no injury to the sewers. It is not necessary to pour it in above a quarter of a mile above the mouths, all that is wanted being complete intermixture.

The CHAIRMAN: Do you think any other agent might be employed which would be more efficient?

Witness: No. Others might be employed; for instance, nearly all the metallic chlorides might effect the object, but they are more expensive, and not to be recommended. Then, too, the milk of lime has this advantage—it remains in combination with the sulphur, and does not reproduce the evil which for a time it remedied. Some of the other agents do not—those which precipitate the sulphur in its natural state; and that sulphur is liable to combine with hydrogen, and you have the same thing over again. The expense of the lime employed at the present time is about £150 a day. I think it is necessary to continue the process about four months in the year. I think there is no other mode which is better. Mr. Wicksteed has completely accomplished the deodorization of the Leicester sewerage by lime; and that is, to a large extent, a case in point, as I know, from having had water-works to construct in that town, that a larger number of water-closets exist there than did before, and there is also a great deal of offensive matters from factories which we do not have in London.

By Sir J. SHELLEY: I would begin with the high-level sewer at once. I ought to mention that the state of the Hackney district, which is drained into the Hackney Brook, is most deplorable, and that more disease exists there than ever known before. That district would be relieved by the high-level sewer immediately.

The CHAIRMAN: You say you have read everything upon the subject. Do you fancy, from all the evidence given here and elsewhere, that there is sufficient engineering and chemical information offered to warrant any plan being carried out at once?

Witness: I have no doubt myself upon that subject, but it would ill become me to answer the question in the affirmative.

The CHAIRMAN: You fancy that there is?

Witness: Yes; the plan which I have had the honour of agreeing in with other gentlemen has been before most of the eminent engineers of the day, and amongst those gentlemen there is a perfect concurrence of opinion, so that it does not rest on my judgment alone.

By Mr. PERCY: The foulness of the water at Teddington Lock was from accidental circumstances. Drs. Hoffman and Witt last year analyzed the water of the Thames, beginning at Kew and ending at the Victoria Docks, and throughout they found that the organic matter was almost exactly the same, and scarcely anywhere exceeded two grains in a gallon. That was owing to the rapid state of decomposition. At Kew it was 1·8 grain, at Fulham 1·99, at Wandsworth 2·3, at Westminster Bridge 1·9, at London Bridge 2·2, and at Victoria Docks, which is the point at which, as I have said, the effects of entire deodorization were apparent, it became reduced again to exactly 2 grains. That is a very different state of things to that which exists in the Thames now.

Mr. PERCY: After you have treated the sewerage matter with lime, will not decomposition go on by the sulphates escaping from the lime as they do from gas-works?

Witness: No. The sulphur in gas-works passes into the state of sulphurous acid. When the sulphuret of calcium is laid out in the open air it combines with the oxygen; a considerable amount of heat is generated, and the lime passes into a state of sulphite of lime. Of course, during the progress there is an effluvium given off which is by no means pleasant nor healthy, though I have been in it for three or four days and have not suffered at all.

By Mr. STEPHENSON: The plan which Mr. Bidder, Mr. Bazalgette, and I have reported upon is not a plan of my own; it is one which, in one form or other, has been before the Commissioners of Sewers for thirteen years.

Objection was taken to any further questioning upon the details of any plan, and after some conversation on the point the committee adjourned.

THURSDAY, JULY 15.

J. W. Bazalgette, Esq., recalled.

The CHAIRMAN: We left all further inquiry as to the burning of gases until you had made some experiments in the sewer adjoining this House. Have you done so?

Witness: I have. I wish first to state that last Thursday, when called upon unexpectedly by the committee, I had had no opportunity of refreshing my memory as to what had been done on this subject. I have since done so, and I find that at the end of 1854, or the beginning of 1855, application was made to the Metropolitan Commissioners of Sewers by Mr. Gurney, I believe under the direction of Lord Palmerston, to have some gullies trapped in the neighbourhood of this House, in order to afford Mr. Gurney an opportunity of making some experiments in ventilating the sewers in the adjacent district. At that time a committee of the commissioners came down to the House, and I accompanied them, and saw Mr. Gurney's apparatus, and he described what he proposed to do. A clerk of the works under the commissioners, Mr. Scott, also made some experiments upon the effect of the furnace on the Victoria sewer, and reported the result to me. I find that that report was unsatisfactory, for neither the velocity of the air before the furnace was lighted, nor the consumption of coal, nor the actual extent of the sewer drawn, were obtained. I thereupon made a note upon the report of all these particulars which were essential before any opinion could be formed upon the plan. I believe that was the only experiment made at the time. I am not aware of any experiments having been made in 1856. I see in that report that the clerk of the works expressed an opinion that he thought the trial was a failure so far as it had gone. The only work done by the commissioners was to trap the gullies, so as to confine the current in the Victoria sewer. I made a verbal report to the commissioners upon it, and Mr. Gurney also attended and made a statement. I have prepared a plan showing the line of this sewer and its condition. I find that the furnace at the Clock Tower is now connected with a district of about a quarter of a square mile in area, and about 6½ miles of sewers in length. I will now proceed to describe to the committee exactly what has been done since I last gave evidence. On the following day I sent my assistant to Mr. Gurney to make arrangements for carrying out this experiment. The committee must understand that these experiments must be carried out at low water, and can only be conducted for a short period of time: there is, therefore, considerable difficulty in conducting them. Mr. Gurney informed me that the following evening, Saturday, would be an inconvenient time, as the House was not sitting and the furnace not kept up. On Saturday, therefore, Mr. Hawksley, Mr. Haywood, and myself called on Mr. Gurney, but did not find him in, but his clerk of works went to the furnace with us. We examined it and the communications with it, and requested, as the furnace was not to be kept up, that all communication between it and the sewer might be cut off. We then, at half-past six o'clock, low water being at eight o'clock, went round the sewers to see what draught existed in them without the aid of the furnace. We found in Victoria Street, at the head of it, which is seven-eighths of a mile from the furnace, that there was no current. In the same sewer, at five-eighths of a mile and three-eighths of a mile, we observed the same result. In York Street, near James Street, which is also five-eighths of a mile, and which is the sewer leading to Buckingham Palace, we found that the current towards the furnace amounted to 100 feet per minute, which is not a strong current; and it was clear that that current was due to the effect of the atmosphere and local causes. They were allowing the furnace to burn out, and we had taken care to cut off the communication with it by dampers and flaps, which were all carefully fixed by Mr. Gurney's assistant. In Parliament Street, five-eighths of a mile from the furnace, the current up the Victoria sewer amounted to 45 feet per minute, which is half a mile an hour, the former being one mile and an eighth per hour. We then went round College Street and Wood Street, and we found that in those sewers the air was stagnant, and they were so full of coal gas that it appeared dangerous to enter. They are about an eighth and a quarter of a mile from the furnace, and there had evidently been an escape of gas in them for some time. On Monday, at eight o'clock in the morning, we again met at the Clock Tower, and Mr. Gurney not being there, we went with his assistant to the furnace. We then connected the flue with the furnace, without the steam-jet, and we found that we obtained a current of air equal to 441 feet per minute in the Clock Tower. The furnace was then got up to its usual working power, and the current was then passed through it. We tested it again with the steam-jet, and we found that we obtained a velocity of 462 feet per minute, or five and a quarter miles an hour, being an increase of velocity equal to 5 per cent. We then went to the side entrance at the end of Great George Street, which is one-eighth of a mile from the furnace, and we found no current of air there. I should state that while we went there we left Mr. Hawksley at the Clock Tower, testing the pressure of the air caused by the furnace. We thought it strange that we found no current, and I sent a man up the sewer to see whether it was clear to the furnace. He found a flap in the sewer which closed the connexion, and I directed him to open it. This induced me to make inquiry when that flap was constructed, and how long it had been there, because it completely shut off all communication between the Clock Tower and the sewer in the surrounding district. From reports, I find that that flap was constructed by Sir Charles Barry in 1842; and that four years ago, when Mr. Scott made his experiment, he propped it up for the time being; and that that flap has since then been down, so that the draught in the Clock Tower has not been drawn from that sewer at all. On the back of that flap there was a great deal of gas, and the man who propped it up was obliged to put out his lantern. As soon as he did so an explosion took place in the Clock Tower, and the instrument with which Mr. Hawksley was working was shaken. Mr. Hawksley was outside the chamber, and distinctly felt the shock; but we were not aware of that fact till afterwards, and we proceeded with our examination of the currents of air in the sewer. We then found that there was still no current of air in Great George Street sewer. From thence we went to the side entrance in Victoria Street, three-eighths of a mile from the furnace, and we found that there was a velocity towards the furnace equal to 76 feet per minute, or seven-eighths of a mile per hour. At five-eighths of a mile from the furnace, there was a current towards it of 62½ feet, or between a half and three-quarters of a mile per hour. These currents, you will perceive, are less than existed in the York-Street sewer, without the furnace, which shows how small it must have been. We found it very variable; at times it ceased, then it moved again, and at times it had a tendency the other way. At seven-eighths of a mile from the furnace we found that there was a current of 58 feet per minute towards it, and we then proceeded to gauge the York-Street sewer, which is five-eighths of a mile from the furnace. Upon this occasion we found no current whatever, which was owing to some change in the state of the atmosphere or in the wind. Having found that the flap was down when we tested the velocity of the current in the chimney, we went the next morning to test the velocity with the flap open. We found that it was then increased to 542 feet per minute, or 6½ miles per hour. We were then passing the whole current of air under the furnace. I left a person there to check the quantity of fuel which was being used, and which I had not been able to obtain, and requested that everything might remain unaltered until our return. We then proceeded to Great George Street again, and we there found that above the ventilator in that street there was a current towards the furnace of 19 feet per minute, and below the ventilator of 8 feet per minute, showing that the difference of 11 feet must be passing up the ventilator, and the rest passing along the sewer towards the furnace. In Victoria-Street sewer we found, three-eighths of a mile from the furnace, there was a velocity of 102½ feet per minute, or 1⅛ of a mile per hour. This was the greatest velocity we obtained. At five-eighths of a mile from the furnace there was no current above the ventilator, and below there was a current of 50 feet per minute. At seven-eighths of a mile there was a current above the ventilator of 25 feet, and below of 5 feet per minute. When the side entrance was opened, there was found no current below the ventilator, which was stopped completely. We then went to York Street, near to James Street, five-eighths of a mile from the furnace, and we found that in that sewer there was no current. We then returned to the furnace to ascertain the amount of fuel consumed. We then heard that at 10.45 the air from the House passed over the furnace, and therefore that, to some extent, vitiated our experiment. To check that I directed my assistant to go at low water next day and test it, first with the doors closed, and then with the arrangement as made by Mr. Gurney, to ascertain what difference it made; but he was informed that he could not be allowed to go, as the ventilation of the House was proceeding, and therefore we were unable to ascertain it with correctness. He then went into the sewers in Great College Street, Wood Street, and Abingdon Street, and found them very full of coal gas. There was also a large amount of deposit, and, in fact, they were unsafe to be entered. Now, first of all, the flap which exists between the furnace and those sewers cut off all ventilation; but, supposing there had been no flap, these sewers are connected with the channel leading to the furnace by a 15-inch pipe, which is, in fact, isolating them from the furnace. The other sewers have free communication at the sides of the channel. The velocity through that 15-inch pipe would be so small that it would be insufficient to ventilate the sewers. I do not know who put that pipe there, nor by whose order it was done, but it has been done for some considerable time. I should state that Mr. Gurney has great difficulty with the furnace as arranged. First of all, his chimney is stopped up to a great extent by planks and buildings in the tower; his communications with the sewers are those where works are in progress, and the gullies and openings are not trapped tight; therefore the effect upon the sewers in that district is nothing. Having come to that conclusion, the next thing I directed my attention to was this,—Supposing the whole of the air to be pumped out by means of that furnace which was produced by the sewers, and supposing all intermediate channels could be stopped, and it could be collected from the ends of each sewer and distributed over the whole with theoretic accuracy, the effect upon those sewers would be nothing. The way in which I show that is this:—The total area of the sewers—that is, the 6½ miles of sewers connected with the furnace—is 713 feet. The total area of the channels through which the air has to be brought is 8 feet, or about the 90th part of the 713. The air was passing at the rate of 542 feet per minute through this 8-feet area; and therefore, if I could divide that over the entire district, the velocity in the sewers would be 1-90th of the whole, or 1-15th per mile per hour; and there exists in the sewers from other causes a velocity amounting to 100 feet per minute and upwards. We took the velocities inversely as the ratio.

Mr. STEPHENSON: You are aware that that is not practically true, for the friction in the smaller passages would be smaller in proportion?

Witness: Undoubtedly; but I have cast that overboard. Supposing that all the air produced at this furnace was straight through the whole 6½ miles of sewer, you will only get a velocity of one-fifteenth of a mile per hour, which is no ventilation at all. While we were making our observations on Tuesday, and the furnace was being kept up, we found that the consumption of coke was at the rate of eight chaldrons per day; but I assume that the defective arrangement—*i. e.*, the chimney of the furnace being partially stopped up and the connexions not being perfect, may necessitate a larger consumption of fuel than would be required if there was a better arrangement. I will therefore suppose that four chaldrons of coke would produce the necessary current of air, and effectually ventilate that 6½ miles of sewer—which, however, I think I have shown to be impossible. Then, I find that for the 1500 miles of sewers in the metropolis (some of which are now open, but which eventually would all be closed and require ventilation) it would necessitate the construction of 237 such furnaces, and that the cost of coke for each would be £876 per annum, and, taking that at four chaldrons, the total cost for coke alone would be £201,480 a year, without

any allowance for labour or incidental expenses. The prime cost of those 237 chimneys or furnaces, with their establishments, I put down at £2000 each, which will give a sum total of £474,000, or nearly half a million of money. My inquiries on this occasion have led to much the same result as on previous ones, and I am only sorry that Mr. Gurney was not with us to see the experiments tried. It would have been more satisfactory to me had his engagements allowed him to do so.

By Mr. ROUPELL: I have no doubt the gas in the College-Street sewer was the accumulation of a long period. I think the conditions of the experiments which we made might be improved, but the evidence I have laid before the committee shows that no improvement would render the scheme practical. I think the experiment was sufficient to establish the conclusion to which I have arrived. I have not considered what the annual cost of superintendence would be. The consumption of coke came to such an enormous amount that I considered it quite unnecessary to do so.

By Mr. AKROYD: I am the engineer of the scheme of the Metropolitan Board with an outfall at Barking Creek. The estimated expense is £2,500,000. The interest upon that outlay at 4 per cent. would be £80,000 a year.

Mr. AKROYD: In addition to that you propose to deodorize?

The question was objected to, but

Witness said: It is not proposed to deodorize all through the year, but only a portion of it.

Mr. AKROYD: What do you estimate the cost of that will be?

Witness: I find a difficulty in giving an estimate, because all the data which we have at the present time are based upon small works in small towns, which I think are hardly applicable to London. I think that, upon the large scale we should be able to deodorize, we could do it at a lower rate. So far as I have been able to estimate the subject, we may put the cost down at £40,000 per annum for a period of six months in each year. That sum includes the cost of keeping the works in repair and the salaries of all officers, &c.

Mr. AKROYD: That scheme depends for success upon this single fact—whether or not the sewerage discharged at Barking would find its way back to the metropolis by the upcast of the tide?

Witness: If deodorized, I apprehend it might pass up without injury.

Lord J. MANNERS: I think we had better confine our attention to one thing at a time. The question just answered does not refer to the plan we are now inquiring into.

Witness said he should like to offer some further explanation upon the subject if the question were allowed to stand.

After some remarks by Mr. STEPHENSON the question and reply were struck out.

By Sir J. SHELLEY: I have no doubt I can obtain information of the fact as to who placed the 15-inch pipe in the sewer. It was before the Metropolitan Board was in existence. The sewerage matter runs in the opposite direction, so that the pipe in no way affected the sewer itself. I think it would not be safe to remove the flap, as it prevents the tide flowing up the sewer of the House of Commons.

Mr. *Gurney* recalled, and examined by the CHAIRMAN.

I desired that the furnace of the ventilating-shaft should be placed at the disposal of the Metropolitan Board of Works. I gave directions that such should be the case, but the only period in which it could be examined was on Monday, as on Saturday the tide locked the sewer all day, and in the evening there was no House. Application was made to try the experiment on Sunday, but I objected to its being done. On Monday morning, when I returned from the country, I found the person in charge of the apparatus, who told me some tricks had been played, for the furnace would not draw, except in the law courts and the Houses of Parliament, and said we must send some one down to examine it as it had not been so before for many years. I desired a gentleman in whom I had confidence, and not connected at all with the Houses of Parliament, or the Office of Works, or the Commissioners of Sewers, to go down and see what was the matter. That gentleman is now in the room, and can give evidence as to what he found. I should state that between the sewers of this House and the sewers belonging to the commissioners there is an iron grating fixed, so that no one can go from the sewers of the House to the street, nor from there come to us. We can only get to that sewer through Victoria Street. That gentleman reported that he had been up as far as the grating —quite to the end of the jurisdiction of the Office of Works, and that he found the end of the sewer shut off. I said, "Possibly it may be done as an experiment." He waited for an hour, and went down again and found it still shut. At half-past ten the tide began to rise, and the sewer was water-logged, but the flap by that time had been opened, which shows that it must have been intentional, and, if so, it ought not to be sanctioned. I felt exceedingly disgusted at it. On Tuesday morning my man in charge came to me and said that they were passing the whole of the air under the furnace, and not through the reverberatory channels; and that, in consequence, the bars were melting. I said you must not suffer that, but put it into its normal condition. The experiments, therefore, on Tuesday were as unsatisfactory as those on Monday, and showed nothing. I hope, if it is tried again, it will be done by disinterested parties. In regard to the explosion of gas, I should say if that flap were shut down it shows neglect on the part of the Commissioners of Sewers.

The CHAIRMAN: Part of the evidence given is this—that supposing everything was in the most perfect order, and you only consumed half the quantity of coke, it would cost to carry out your plan through the whole metropolis £201,000 a year, and take £1,500,000 to erect the furnaces, not at all taking into consideration the cost of working.

Witness: I will go into that question presently; but there is some explanation wanted about a 15-inch iron tube. That was placed there for the purpose of ventilating the law courts, which were in a horrid state in consequence of the gas coming up the sewers. I was called upon by Sir W. Molesworth to correct that nuisance, and I trapped the gullies and ordered the ventilation to be through this pipe. It was done with the knowledge and under the direction of the officers of the Commissioners of Sewers. With reference to the flap which stops the communication between the sewers, I know nothing about it, as we could not get through the grating I have referred to. If it was placed there by Sir Charles Barry, the commissioners ought to have seen that it was kept up. I know that in 1854 an experiment was made by Mr. Scott in these sewers, and that the results were very different; those were true results, but these are not. With regard to the fuel used, I may state that it is 5 chaldrons a week. The quantity of gas which is generated by the whole of the sewers of the metropolis is about 500,000 cubic feet per day, and allowing for that to be diluted with 100 per cent. of common air, three such furnaces and shafts as we have here would consume it.

Mr. TITE: You complain that the experiments made by Mr. Bazalgette were not fairly conducted, and you spoke of persons being interested?

Witness: I infer so from the mode in which the thing was done.

Mr. TITE: I cannot conceive on what ground you make a charge of professional men being interested?

Witness: I can.

By Lord J. MANNERS: I do not know anything at all about the flap, nor whether it is necessary to prevent the sewer being water-logged. From the report of the men in charge of the furnace it has not been habitually down. It was open, to my certain knowledge, for two or three years after Mr. Scott made his experiments, and there was no interruption between the House of Commons and the Victoria sewer for that period; for not only did the gases come out of the sewer, but the water also, and put out our furnace.

By Sir B. HALL: I have never sent to see whether it is open, because if the House is ventilated, I have nothing to do with the Commissioners of Sewers. I say that any conclusion upon the experiment just tried would be fallacious.

By Mr. STEPHENSON: I have made an analysis myself of the quantity of air which usually occupies a sewer. It varied very much, but I never knew it diluted with less than 100 or 150 of atmospheric air to one of sulphuretted hydrogen. Perhaps I may state that there are some gases found in sewers which are exceedingly important to have examined, as cyanogen and prussic acid in a gaseous form.

By Mr. PERCY: The diameter of my sewer is 15 feet.

By Alderman CUBITT: I do not wish the experiments to be gone into again for my own satisfaction, because I consider my report is supported by other parties; but if it is done, I should wish it to be done by disinterested parties. With Mr. Scott's examination I should be content to let the matter stand as it is.

Sir B. HALL, considering that the honourable member (Alderman Cubitt) had committed himself to an opinion favourable to Mr. Gurney's plan by the mode in which he had examined the witness, desired to put a question on the minutes in which he stated his conviction "that the experiments (of Mr. Gurney), as a whole, are unsatisfactory."

Witness: I think the honourable member will change his opinion when he reads my evidence.

Mr. *Woodthorpe*, examined by the CHAIRMAN.

On Monday last, at the desire of Mr. Gurney, I took a man with me and went down into the sewer, and had some difficulty in getting through the grating referred to. I was rather surprised when I got up to it to find there was no draught. It was rather difficult to see through by the aid of the lamp, but I imagined that, at the distance of some 20 or 25 feet from it, there was a sheet of iron in the sewer. I came back and explained this to Mr. Gurney, and, at his request, went down again. I found the door open then, but there was no great pull from the Clock Tower as the tide had advanced considerably. The only other investigations I made were to-day, when Mr. Gurney asked me to look out and see the state of the ventilating shafts in the roads. I found some three dozen in the neighbourhood of Oxford Street and Holborn; most of them were closed, but in Victoria Street there were sixteen, nearly all open. As far as the experiment of Monday goes, I should say that no results of a satisfactory nature could be obtained. I may, perhaps, be allowed to say that, from experience, I know if the air is made to pass through the bars of a furnace, not a twentieth would pass that should do, and at the same time the bars would be destroyed, while there would be an enormous consumption of fuel.

By Mr. ROUPELL: I could not distinctly tell in the distance what the obstruction in the sewer was. There are two flaps in the sewer belonging to the House, before you get to the grating. They are self-acting, and have been in the state in which they now are for a considerable time.

Mr. STEPHENSON: You said when the whole of the air was passing through the furnace, and not through the reverberatory channel, the bars were heated and the consumption of fuel increased. Now, the amount of air passing through a stack of chimneys depends upon its temperature—the higher the temperature the more passes up. When the larger portion of the air was allowed to go through the reverberatory drift, the temperature of the shaft would be reduced?

Witness: To a certain extent, but not much, because the air which passes through this drift passes at the same time over the fire, and is heated nearly to the same temperature as that which goes over the bars.

Mr. STEPHENSON: When the air passes through the furnace the temperature is increased, and there is a greater discharge from the chimney?

Witness: It is one thing to force air through a furnace, and another to pull it through—the power of this furnace is a pulling power.

Mr. *Scott*, examined by the CHAIRMAN.

I am a civil engineer, and in 1854 I made some experiments in the Victoria sewer, which I reported to Mr. Bazalgette. [Witness read large portions of that report, from which it appears that, as the result of his experiment, the velocity of the current of air was 1500 feet per minute.] I have not made any experiments when the furnace was not in action, but from my experience in sewers I can only attribute the great draught I found here to the effect of the furnace. I never tried currents of air in other sewers; this was the only experiment I ever made. I know there is a flap in this sewer, as we propped it up when this experiment was made. When it is down all communication between the tower and the sewer ceases. I am not quite certain whether we put it down again. It is not essential that it should be so; it is one of four flaps in the sewer called tide-flaps or pen-stocks. I believe Mr. Bazalgette did not consider my report satisfactory—there was a want of certain information to make it complete. He put this pencil memorandum upon the report—"To obtain useful deductions from these experiments it is necessary to ascertain the amount of fuel which was being consumed in a given period—first without the jet, and then with it—in generating steam from the furnace; what number of jets there were, what size, and what pressure of steam upon the square inch. The openings into the sewers should be shown upon the plan, and if a further opportunity of trying the experiment offers, all the inlets for air should, one after another, be stopped by laying sand-bags over the gullies."

By Mr. STEPHENSON: In this experiment respecting the velocity of the air we made use of the anemometer at first, and afterwards we depended upon the angle of the flame of a wax candle, as we found that from some cause or other the anemometer would not act. It might have been from the smallness of the current in some degree. I have never had the opportunity of comparing the results of the anemometer with the angle to which the flame of a candle may be driven. The estimate of a velocity of 1500 feet per minute, when the flame was at an angle of 45 degrees, is not based on any experiment. I remember at the time that Mr. Gurney requested us to take wax candles into the sewer in case the current was so slight as not to affect the anemometer, and he mentioned that if the flame was carried out horizontally it showed a current of 2000 feet.

Mr. STEPHENSON: If you were dependent upon the angle to which the flame of a candle was driven, does not that convey to your mind the idea that the current was extremely feeble?

Witness: I am certain it was not, as it was perceptible to our faces.

By Lord J. MANNERS: The furnace is not now in the same state as when I made the experiment, as a portion of the shaft is arched over to get the bell into the Clock Tower; so that the area is only about one-half what it was.

By Mr. ROUPELL: I do not know whether the current required to move sewerage gases is very small. I have never tried a feather balance.

Mr. *Kelly*, examined by the CHAIRMAN.

I am clerk of the works to Mr. Gurney. I do not recollect the quantity of fuel which was being consumed when Mr. Scott made his experiments. I was present when the experiments were made on Monday last. There was a good fire kept up, but not larger than usual. The average consumption of coke is five chaldrons a week; that is all that is allowed, and we cannot burn more. The error arises in this way. Mr. Bazalgette has estimated the consumption at that time as a gross constant quantity. If the shaft were constantly going there would be no alternation of heat and cold, and consequently a much less quantity of fuel would be consumed, and yet produce the same results.

W. Haywood, Esq., examined by the CHAIRMAN.

I was present on the occasion, and I believe the experiments were as fairly taken as they could be in such a hurry, and carried on in such a manner. I do not mean to say that they were of that refined and careful character which a professional man would desire; and if the results came to be so nicely balanced that a difference of opinion might be effected by a little alteration, I should think they ought to be rejected; but they established so broadly my own previous conclusions and all the evidence I have given to the committee, that I have no hesitation in saying that my views are more than confirmed by these results.

Witness was examined at some length, as was also Mr. *Hawksley*, upon the mode of conducting and the results obtained by the experiments, in which they expressed their entire concurrence with Mr. Bazalgette.

Mr. *Gurney*, at his own request, was re-examined in reply to some of the statements made, and also for the purpose of laying before the committee his views as to the analogy between the ventilation of sewers and coal mines.

Thomas Wicksteed, Esq., examined by the CHAIRMAN.

I am a civil engineer. I have given a great deal of attention to the subject of the deodorization of sewerage matters, and have erected works for the purpose at Leicester. In that town we deodorize about 2,000,000 gallons of the general sewerage daily. There is but a small proportion of water-closets in the place, but the water supply passes through the cesspools in which the soil is deposited, and therefore it is very fertile in sewerage refuse. I cannot, however, tell what proportion of fœcal matter there is in it. The principle adopted by me in laying out the sewers for the corporation of Leicester was this—that each of the sewers, as far as possible, should have a fall with a velocity of about 3 feet per second, or 180 feet per minute, that velocity being sufficient to prevent any deposition taking place in the sewer; and upon the principle that if no deposition took place there would be no decomposition and no offensive and noxious gases. I believe I succeeded most completely in accomplishing that, as during the last three years no deposit has taken place, and I have not heard of any gases escaping from the sewers. To obtain this velocity in the Leicester sewers, it was necessary to have recourse to artificial means; that is to say, we required the sewerage to fall nine feet lower than the natural fall of the river. This applies to the ordinary sewerage water; the extraordinary—viz., that arising from storms and rain—is carried off at the natural level of the river. As the sewers were laid out with a view to combine deodorization works from the main or trunk sewer, we took a branch sewer through those works to a pumping-station, and by keeping the pumps constantly at work the low level of the artificial system is preserved. The operation of deodorizing is simply this: the water is pumped up by the pumps of the steam-engine, and is passed from thence to a reservoir, and in its passage a stream of lime-water is forced into it. The effect of this stream of lime-water is, that when the sewer-water is exposed to it the gases become fixed, and the mixed liquors have no smell. The object, however, being to get as large a precipitation as possible, and to separate not only the suspended matter, but a large proportion of the organic matter which is dissolved in the sewer-water, it was required that a more perfect mixture should take place than could be by the first operation of forcing the stream of lime-water into the sewerage. The pipe, therefore, passes through a chamber in which they are severely agitated, and from thence it is carried to the reservoir, where it immediately begins to deposit a large quantity of the mechanically suspended refuse, and a portion of that which is held in solution. It passes through at a very slow rate, probably a quarter of an inch in a second, and the water then passes off in a state of comparative purity, in which state it is delivered into the river or mill-pond. In the meantime the deposit which has taken place is raised by means of an archimedean screw in the bottom of the reservoir, that bottom being formed in slopes, and terminating in an open drain in the works. The matter is drawn from underneath, and is then raised up to a tank, which tank runs to a filtering-press, where the rest of the water is squeezed out; and we get cakes about three inches square in a state of dryness equal to that of a brick in a brickmaker's field, when he has turned it up. At Leicester the idea was that we should have a large quantity of a valuable deposit, but our anticipations have not turned out to be correct. Indeed the value of the material is less now than it was, and the company are now carrying on the works more with the idea of deodorizing for sanitary purposes than for manufacturing ones. At the same time, I should inform you that they have lately entered into an arrangement with Mr. Lindsey Blyth, who has discovered an ingredient which he proposes to mix with the sewerage water before it is exposed to the lime process, and which he states will render it more valuable, as well as necessitate the employment of a less quantity of lime. The annual expenses incurred at Leicester have been very great since the first year, because the works were experimental works. Believing in the statements made by chemists, that a valuable matter was to be obtained from the sewer-water, the question was how to collect it. A considerable sum was expended in endeavouring to ascertain this, so that the cost of the works at Leicester is no guide as to what it should be. If works were provided in London, and the quantity of lime used was similar to that employed at Leicester in 1856, I should say that a ton of lime would deodorize 1,000,000 gallons of sewerage water, and that the cost of deodorizing that quantity, including the lime and labour, would be 21s. 6d. In a sanitary point of view the process has undoubtedly succeeded, and I believe it could be effectually applied on a much larger scale to London. My opinion —without having gone into the subject with minuteness, as an engineer— is, that the most complete plan would be to adopt the present proposition for intercepting sewers, and to erect deodorizing works, first of all, for the western area of the north side of the river, and, finally, deodorizing works for the eastern side in West Ham Marshes, and for the southern side at Deptford. In fact, as the sewer-water after passing through the process is perfectly pure, it matters not in what part of the river it is put, and the determination of the site of the works would be a question for the engineers to settle. The cost of works for carrying on the process of deodorization and consolidating the manure so as to be delivered in barges, for a population of 3,000,000, would at the outside, exclusive of the purchase of land, be £160,000; and those works would be capable of deodorizing 144,000,000 gallons per diem. The cost of apparatus for raising that deposit from the bottom of the reservoir and passing it through the press would be £30,000 additional, making a total cost of £190,000. I have also made a calculation of the annual expense upon two suppositions—the first, that a ton of lime is used; and the second, 9½ cwt. to each million gallons, which I understand they have been doing at Leicester during the last twelve months. Taking the larger quantity of lime and the greater quantity of deposit, the annual cost would be £56,500, and the cost of raising the precipitate from the bottom of the reservoir and press-drying it, at 2s. 6d. per ton, £25,000. With 9½ cwt. the first sum would be 14s. instead of 21s. 6d., amounting to £36,790, and the raising of the precipitate £9900, or a total of about £47,000 a year. The value of the material is so small at present that it does not pay the expense of carriage, and I do not think a market could be created for it. It must be carted away somewhere; it would make a good soil, for, as I understand, it is better than garden-mould, and is very inoffensive. I have not estimated the cost of taking it away. My estimate of the annual working cost leaves off when the material has got to the barges. I am not prepared to say whether the cost of removal could be defrayed by the little value there is in the material. I cannot of myself say that, if thrown into the river near the sea, there are no ingredients which would return with the tide and be prejudicial, but it is the opinion of chemists that there are not.

By Mr. ROUPELL: The quantity sent out from the Leicester works at one time was very considerable, but of late there has been no market for it. I reported in 1854 upon the treatment of the London sewerage by deodorization, and suggested four establishments for the purpose smaller than that at Leicester. I have not since changed my opinion as to the effect of deodorizing, nor of the suggested position of the works.

By Mr. TITE: The largest sewer in Leicester is a circular one of 56 inches diameter, with a fall of 5¼ feet per mile, or 1 in 916, and the velocity is 180 feet per minute. A 22-inch sewer, with the same velocity, required a fall of 13½ feet, or 1 in 392. Except in extreme floods, the pumping is equal to the flow night and day. At those periods the sewerage is so diluted that it is not worse than the water in the river itself.

By Sir B. HALL: It is not necessary on account of the works that they should be situated outside the metropolis, but I suggested it as not interfering with any buildings in the town.

By Sir J. Y. BULLER: I should recommend the use of the smaller quantity of lime in the process, as there would be less material to remove.

By Lord PALMERSTON: At Leicester we offered the material for sale, and many times obtained £2 per ton for it; but that had been high-dried.

By the CHAIRMAN: The river has been restored to that state of purity that the fish have returned and come up to the works.

Mr. *W. Fothergill Cook*, examined by the CHAIRMAN.

I am connected with the sewerage works at Leicester. In consequence of the small demand for the material we have economized the works as much as possible, and instead of pressing it now, we pump it up as slush, and run it off into a tank, where we allow it to settle and dry. Since I have taken the works I have reduced the quantity of lime employed, and instead of a ton to a million gallons, I now use 4, 6, or 8 cwt., according to the necessity. The water is not quite so clear, but it is almost a pure stream; the quantity of manure is less, but the value is greater. We thoroughly deodorize the sewerage to the satisfaction of the town. There is not the slightest smell at the works, except when the slush is being pumped out. I have reduced the expenditure by one half. I think the cost of erecting works for a population of 100,000 would be about £6000, and the annual expenses £1250. Experience at Leicester, where at present the expenses are £26 per week, has indicated very great improvements in the plan. At King's Scholar Pond sewer in London, by a very simple arrangement of the sides of the weir, it is capable of deodorizing 4,000,000 gallons per day. I am inclined to think that the process might be applied to the mouth of that and some other sewers. As a private speculation, I should not mind undertaking to do it.

By Mr. ROUPELL: An estimate of the cost for London upon the basis of the cost at Leicester would be excessive, because there we are pumping 4,000,000 gallons of water a day, independent of the deodorizing. If I had to erect the works at Leicester, I could do it at one-fourth of the expense.

By Mr. TITE: I think the commercial value of this material is increasing. We have tried with satisfaction another agent than lime, by which the manure is more than as rich again in ammonia. That agent is coprolites, acted upon by hydrochloric acid and magnesia. Mr. Blyth, who has patented the process, calls it, I believe, "coproline."

By Alderman CUBITT: To work well, I should like to have a space of 40 feet by 200 for every million cubic feet of sewerage, so as to allow of its resting two hours before being pumped out. The whole sewerage of London would be only about thirty times the quantity we are dealing with at Leicester.

By Lord PALMERSTON: I have never tried sulphate of alumina as a precipitant. I know it has been used, but has not answered on account of the first cost. I have never tried manganese in any shape. The price at which the manure is being sold at Leicester now is 1s. per ton, which is about a fifth of the expense. We make about 3½ tons per 1,000,000 gallons, and 5s. a ton would repay us. The most distant place to which it has been carted is 2¼ miles. One farmer took it about five or six miles; but he is a spirited man, and wished to try the experiment. When taken out it is about half water and half fibrous matter; it was pressed first of all about 60 per cent. The way in which it is applied is by throwing it on the land and breaking it up. If dried entirely a roller has to be applied, which brings it down into a fine dry powder. They apply it to all kinds of crops, but the success has not been so great until this year as to induce the farmers to come again. For some months we had no order, but now it is more satisfactory. It has answered very well for grass, and we have tried it for that purpose in front of the works. In particular cases it has answered for corn crops, and there is a proposition now for clearing our yard once a month. The land round Leicester is very valuable—there is no sandy ground—and it is used extensively for market gardens.

By Sir J. SHELLEY: Mr. Blyth has taken a share with us in the works. We have only made one experiment with coprolites. In large quantities, I believe it can be bought at £3 per ton.

By Lord J. MANNERS: We deodorize all the year round in Leicester.

The CHAIRMAN: According to your estimate you would require only £180,000 or £200,000 to erect works for the whole of the metropolis, and £36,000 for the working expenses, independently of the removal of the stuff afterwards.

The room was then cleared, and the committee remained in consultation until the close of their sitting. They appear to have decided not to receive further evidence, as they met yesterday to consider their report.

Legal Intelligence.

VICE-CHANCELLOR'S COURT.

WEDNESDAY, JULY 14.

(*Before Vice-Chancellor Sir* W. PAGE WOOD.)

DELARUE *v.* THE ALDERSHOT AND SHORNCLIFFE MANURE COMPANY.

Mr. ROLT and Mr. FOOKS moved for an injunction to restrain the defendants from carrying on any business or operations upon their land at Ash, in Surrey, whereby any noxious or pestilential vapours or stinks were allowed to emanate and diffuse themselves over the property of the plaintiffs at Ash, so as to pollute the atmosphere and render it prejudicial to life and health, or liable to engender disease in persons occupying or resorting to the plaintiffs' manufactory and premises, and generally to restrain the defendants from carrying on any business or operations so as to be a nuisance or annoyance to the owners and occupiers of the plaintiffs' manufactory. The plaintiffs—Messrs. Delarue, the wholesale stationers and envelope manufacturers—were owners of about twenty-four acres of land at Ash Common, and a dwelling-house thereon used by them for the purposes of their trade, the greater part of the land being laid out in gardens and pleasure-grounds. The defendants were an incorporated joint-stock company, with limited liability, established "for the manufacture and the sale of manures, and the doing of all such things as are incidental and conducive to, or as the company may from time to time deem expedient for, the attainment of such objects, or either of them." The company carried on business at Ash Common, upon a piece of land furnished with tanks, reservoirs, and other apparatus, about 600 yards from the plaintiffs' premises; and it was alleged in the bill that the business of the company (the subject matter of their operations being the night-soil from Aldershot Camp) was carried on so as to completely poison the atmosphere, and render it unwholesome and prejudicial to life and health to the occupants of the plaintiffs' manufactory, which was thereby rendered unhealthy and unfit for human habitation. It appeared that the premises now occupied by the defendants had been previously occupied by "The Aldershot and Shorncliffe Manure Company," carrying on similar operations. In July, 1856, the plaintiffs commenced an action against that company for a nuisance, and obtained an injunction at common law restraining the company, under the penalty of £1000, from continuing the nuisance. The defendants had been in the occupation of the premises about eleven months, and had, immediately upon their taking possession, received notice of the result of the proceedings against their predecessors. The nuisance for some time had been greatly mitigated, but latterly, during the hot weather and the crowded state of the camp, it had increased to such an extent as to compel the plaintiffs to file their bill to restrain the defendants from continuing the nuisance, and an injunction was now applied for.

A considerable amount of evidence, scientific and other, and somewhat conflicting in its character, was adduced as to the existence and extent of the nuisance complained of.

Mr. W. M. JAMES and Mr. C. T. SIMPSON, for the defendants, contended that the complaints of the plaintiffs were clearly of an exaggerated character, and that an injunction ought not to be granted without directing an action at law.

The VICE-CHANCELLOR, in delivering judgment, said: It appears to me I must grant this injunction—that the defendants are not in a position to require the further intervention of a jury after what has taken place, and after the evidence before me with regard to the damage and injury which these plaintiffs have sustained. I have been referring to the case of *Broadbent v. Imperial Gas Company*, where unquestionably the Lord Chancellor first had a very strong impression that I had gone too far in granting a perpetual injunction without the intervention of a jury. However, on the case being reargued, and certain points of law unexpectedly arising, in which he had the assistance of common-law judges, and that having given the Lord Chancellor time to reconsider the whole question, he came to the conclusion that I had not exceeded the just discretion of the court in granting the injunction in that case without the intervention of another trial, inasmuch as there had been a submission to arbitration upon a former occasion with reference to the identical injury complained of, and much evidence gone into and much expense incurred in that investigation. And although the matter had never been before a jury, yet, inasmuch as the parties had chosen arbitration, unless the court was satisfied that the inconvenience which the arbitrator had found to exist was put an end to, it would grant an injunction at once to protect those who had been already chosen the tribunal to determine their rights. What has happened in the case before me is, that the present plaintiff has tried the right with persons from whom the defendants have purchased land, with a full knowledge that the right had been so tried. There is no doubt whatever that everybody must admit the process in question, at all events, to be of a most extraordinarily offensive description. Anything more offensive could hardly be conceived, and I think I may use the expression of the Lord Chancellor in the case that I have referred to, which was a case for damage done to a garden by smuts constantly coming upon his fruit-trees and flowers, where he says—"I do not want chemists and scientific people to tell me that must be injurious." Now, here I do not want chemists or scientific people to tell me that stirring this matter would be offensive at some distance. The question is, at what distance? Eight hundred yards is a long distance, no doubt; but what took place is this:—In 1856 the plaintiff brought an action against a gentleman who then carried on this manufacture, and he was defeated. Then he brought his action on a second nuisance occurring, and in that action the defendants submitted. It appears to me that that is exactly the same as if he had submitted the matter to an arbitrator, or had taken the verdict of a jury. I must take it just as conclusive as if he had paid his £50 into court, and submitted to an order in this form:—"From causing a repetition of the nuisance, and from causing or procuring the continuance of any noxious, offensive vapours, and so forth, proceeding from or out of their tanks and pits, to spread or diffuse themselves over the messuage or dwelling-house, workhouses or shops, gardens, and so on, of the plaintiff in the cause." I think that determined that the manufacture, as then conducted in 1856, did at 800 yards produce an effluvium which was a nuisance to the persons residing at that distance from the premises in question, where the manufactory is carried on. The case does not stop there, because, after some further time, there was a question whether the nuisance had been abated, and whether there was not a continuance of the nuisance, and a motion to commit in consequence. On that motion to commit I have Mr. Grove's report—a more competent arbitrator both upon law and fact could hardly have been selected. He had before him the question upon the affidavits whether or not there had been a repetition of the nuisance, and he was to report upon that; and it appears from the character of the report, also, that he was to consider, or, at all events, he took upon himself to consider, how far he could suggest any alleviation which might be made that might put a stop to the inconvenience complained of. Mr. Grove, upon that occasion, made his report, which is dated the 4th of May, 1857. He speaks of having visited the premises, and he gives an accurate account of the investigation that he made at the time. He says the odour of the mounds of mixed manure at a distance of from thirty to forty yards could hardly be called offensive. That is, after the process of stirring had been stopped. But he speaks of the effects of the stirring, and he says while he was there nine tanks came from the camp; he got one of them turned into a pit, and the smell was very offensive till the charcoal was thrown on, but it then rapidly subsided. The residual odour was rather stronger than that which was emitted after the more offensive odour had subsided, but it was not perceptible at forty or fifty yards. He says that the wind was south-west, and that not being towards the plaintiff's house he walked so as to get into the eye of the wind at a distance equal to that of the plaintiff's house, being about 600 yards. There the odour was just perceptible, and no more. As it appeared to him that the most offensive part of the process was mixing with the charcoal, he suggested that the mixing should be made at or near the camp, and he requested to have a telegraphic message when the offensive smell should be particularly great. It appears that he was not able to go when he was so summoned on the first occasion, and upon the second occasion he could not go at the particular time, and he went twenty-four hours afterwards. I think that is pretty nearly all he states with respect to the actual effect at the plaintiff's premises; but then he goes on to say, that he also had to look into the affidavits, which went to the continuance of the nuisance after the payment of money into court. He comes to the conclusion that there had been occasionally, since the date of the injunction, offensive smells perceptible at the plaintiff's house which he considers would amount to a nuisance, and upon that finding of Mr. Grove the Court of Exchequer ordered that the costs of the inquiry, including his report, should be paid by the defendants. The court, therefore, was of opinion that there had been a repetition of the nuisance. I read Mr. Grove's report thus: that, while he was there, they taking all the pains they could (and if this went to a jury, whenever the jury were called to view there would be every pains taken to render the thing as little objectionable as possible), there was no particularly offensive smell; but with all those pains so taken Mr. Grove says, as far as he was personally concerned, the odour was just perceptible at the plaintiff's house, but that there was that which in law would amount to a nuisance. What he says is this: "On the general question I am of opinion that since the original complaint there has been a great diminution of the offensive character of the works, that by perseverance in the course now adopted by the defendants, with possibly such other improvements as experience suggests, the works may be carried on without occasioning any nuisance to the plaintiffs; but to carry them on will require constant and vigilant superintendence on behalf of the defendants, and any neglect in the precautions used will produce a recurrence of the nuisance." Upon that it is plain what has happened, and it appears to me equally manifest that the defendants may find some way of properly protecting themselves against any evil consequences arising from their works. That report of Mr. Grove comes to this: he finds that with great pains taken the smell was perceptible at the plaintiff's house. Of course there may be a variety of opinions upon that as long as the smell if perceptible at all, and that may be a serious question hereafter. But, he says, finding that state of things with all the pains taken, he considers that unless there be the greatest pains and care taken in the future, there will be a recurrence of the nuisance. The question is materially modified when I come to see what I have to try. I am not embarrassed with the question how this smell would be perceptible at 800 yards, because that is distinctly formed. The smell has been carried from the works to that distance, and it has amounted to a nuisance. I do not consider myself even required to enter on the question of whether or not the smell, when perceived to any great degree, is prejudicial to comfort and health, or whether a person is not to be called tender-nosed upon disliking a smell of that description. I think if the smell be carried in any degree of accumulation to the distance in question, it must be that which renders the dwelling in the house uncomfortable, as the plaintiff swears has been the case. The only question, therefore, is, whether or not there is evidence before me to satisfy me on this occasion that, this matter having been twice before those whom I must take as representing the defendants in the case, the nuisance complained of has recurred. Mr. Grove says that it will recur if very great pains and care are not taken. It appears upon the evidence that alterations have been made since Mr. Grove's report; that more has been done towards getting rid of the evil; but I find very clear, and careful, and tolerably strong evidence with regard to what persons experienced upon the works in May last. But since that the plaintiff, Mr. Delarue, carefully, one day when the wind was blowing in such a direction as to raise the question, traced the smell; and I have a map showing where he began, and which shows that the smell went further than the plaintiff's house and property. Then, the workman who lives on the premises described it as offensive on that day, but he says it was much more offensive on the two preceding days. I have no hesitation in saying that this evidence is quite sufficient to satisfy me that the nuisance has been so repeated that this plaintiff ought to be protected against a recurrence of it; and that he ought to be protected by the injunction of this court to the extent of compelling the defendants to pay that great care and attention which Mr. Grove says is necessary to prevent a recurrence of the evil. To say that the defendants, who have been once convicted of a nuisance of this description—for they represent the defendants who preceded them—and having been obliged to submit to an injunction in respect of this inconvenience, are to be allowed to have the decision of a jury to know what they have now done, would be simply to put those persons near whom they are placed in litigation, and bring about that repeated litigation which it is the object of this court to prevent. As regards delay, if this was a case in which the legal right had to be established, the argument on that ground would be no doubt very strong, and it might reasonably have been said that the court would not grant an injunction on the ground of delay, until the legal right had been tried. It would have been said, "As you have chosen to wait before you came for an injunction, the court will not assist you;" but here the legal right has been ascertained, and what is called delay is merely forbearance on the part of the plaintiff. I do not think it would be reasonable to say that because this plaintiff forbore he is not now entitled to an injunction. If he had occasioned fresh expense by that forbearance, that would be another matter; but the course he took was this—the moment the works were bought he gave notice of his intention to insist upon his rights. No doubt the nuisance is greater during the summer months, because in the winter it appears there was a considerable diminution of manufacture. Indeed, the defendants only say that they are making now as much as they were in March last. The question is, as I have said, whether this gentleman, because he forebore from March till the 1st of June to insist upon his strict rights and to rush into litigation, is on that account, having been in possession of a decision that the matter is a nuisance, to be deprived of the protection previously afforded

to him. It appears to me that this forbearance is rather in his favour. He does not come here upon a matter of nicety—a matter of any peculiar speciality or delicacy, but he is driven to come here by the necessity of the case. It seems to me that whatever may be the case when a permanent injunction comes to be asked for on this evidence, there is no necessity for bringing the case before a jury, when the result will be, that the jury will be taken there when all care and pains have been taken to prevent any inconvenience arising, and the court will not be much helped as to the result. No doubt some of the witnesses say that at twenty yards, or thirty yards, or forty yards they smell nothing; but I consider that evidence disproved by the positive evidence of those who say they do smell it, because the negative evidence is utterly outweighed by the positive—unless you can suggest that there is some extravagant bias, or some extravagant notions of right, or ridiculous susceptibility to smell on the part of the witnesses who say they do smell it. I do not see any reason to suppose anything of the kind, or that the plate-layers and others would come forward and pledge their oaths to it if they had experienced nothing of the nature to which they depose, especially when it is supported by the previous inquiry and finding upon two former occasions. I feel myself fully justified now, upon this interlocutory application, in saying that the plaintiff is entitled to an injunction, and I have no doubt no evil will result to these gentlemen if they manage their manufacture properly. If they do not, they must abide by the consequences. They will be "restrained until further order from causing or procuring a continuance of any offensive or unhealthy vapours, gases, or stenches, to arise or be emitted, so as to diffuse themselves in, upon, over, or about the messuage or dwelling-house, workshops, buildings, pleasure-grounds, or gardens, of or belonging to the plaintiff, situate at Ash, in the county of Surrey, or any part thereof."

Mr. ROLT: The land is very much nearer than the house, and therefore unless "land" is introduced we cannot use it.

The VICE-CHANCELLOR: This is only an interlocutory injunction till the hearing, and the principle is to act upon the inconvenience to human life or comfort.

COURT OF QUEEN'S BENCH.

GUILDHALL, MONDAY, JULY 5, 1858.

(*Before Lord* CAMPBELL *and a Special Jury.*)

HILLS *v.* THE EQUITABLE GAS COMPANY.

Mr. HINDMARSH opened the pleadings.

The ATTORNEY-GENERAL said: My lord, I appear for the plaintiff in this case, Mr. HILLS, who is the author of an invention of the greatest possible value, and which has effected a great amount of public good. The subject of the patent which is now in question before you, is the discovery of a material called hydrated oxide of iron, which is applied to the purification of gas, while in the process of manufacture, for the absorption and the purification of sulphuretted hydrogen, which is evolved in the process of manufacture to an extent and degree which makes all manufactories of gas in which some effectual contrivance is not resorted to to absorb and destroy the sulphuretted hydrogen, a great public nuisance, injurious, and sometimes fatal to the health not only of all who are engaged in its manufacture, but those who happen to be within its reach. You are all, perhaps, aware that in the manufacture of gas, before the period of purification arrives, it is passed through a vessel or vessels, and then at last arrives at a point where it is necessary for the health, and comfort, and the safety of all who are within reach of the manufactory that the sulphuretted hydrogen found in all coal gas, and which is evolved, should be, some how or other, absorbed and carried off or destroyed. For a great many years, ever since gas has become, as we may call it now, one of the necessaries of life, and ever since large manufactories of gas have been established in great numbers in the metropolis, or rather in the neighbourhood of the metropolis, and in the neighbourhood now of every great city and town throughout Great Britain, it had been a desideratum much thought of and often attempted by men of practical knowledge, men of science, and men of skill, to discover a method of completely absorbing and taking away the sulphuretted hydrogen which is produced in the course of manufacture. The principal means resorted to have hitherto been a quantity of lime, by means of which, to some extent, the sulphuretted hydrogen is absorbed, and so carried off. But this was a very insufficient, very troublesome, and a very imperfect mode of attaining that end; and towards the year 1848, the plaintiff, Mr. Hills, who had been engaged in more than one of the companies formed and existing in this metropolis, turned his attention to the subject, and ascertained, after a long series of searching experiments, that the hydrated oxide of iron was a material which, especially if means could be obtained of renewing it as fast as it was made, would be by far the best mode that could be adopted of completely purifying the gas in the process of manufacture from this deleterious and almost fatal substance belonging to it, namely, sulphuretted hydrogen. After many experiments, and after applying them in various ways, and receiving such assistance as might be thought necessary, he has at length, as I believe I may confidently state to you, perfected his design, completed his experiments, and discovered the exact mode in which this may be effected. He ascertained that if this substance could be so prepared, used, and introduced into the process of manufacture, that when the requisite quantity of gas should have passed through it, and the sulphuretted hydrogen should have been completely absorbed, if an influx of atmospheric air could be contrived to be put upon the whole surface so as to cover the oxide of iron it would be absorbed, and the effect of this application of atmospheric air would be a complete renovation of its powers of purification; and if the process was repeated from time to time, the substance would entirely lose its power. This, like every other great invention, is found at last to be very simple. It consists of nothing more than this chemical ingredient, the hydrated oxide of iron, which, when used in the purification of gas in the course of manufacture, completely takes away the sulphuretted hydrogen, and effects an improvement in that manufacture which, I believe, is quite unequalled by any discovery which has ever yet been made since the manufacture of gas began in this country. The original patent was for a new mode of compressing peat for making fuel, which has been abandoned—or, as it is called in the law of patents, disclaimed—and we have now only to deal with a patent for an improved mode of manufacturing gas. The plaintiff describes his patent in this way:—"My improvements in the purification of gas, and in obtaining certain products, consist of a method of purifying it from sulphuretted hydrogen, cyanogen, and ammonia, by passing it through the following porous material, and of renovating the material employed after it has become inert, and of obtaining the sulphur, cyanogen, and ammonia (either alone or in combination) which were contained in the gas. I effect this in the following manner:—I take the subsulphates, the oxychlorides, or the hydrated or precipitated oxides of iron (which I prefer to use in a rather damp state), either by themselves or mixed with sulphate of lime, or sulphate or muriate of magnesia, baryta, stronlia, potash, or soda, and absorb them into, or mix them with, sawdust or peat charcoal, in coarse powder or breeze, or other porous or absorbent material, so as to make a very porous substance easily permeable by the gas." The short effect of this is, that he takes this substance, the hydrated oxide of iron—which is, in truth, what we might familiarly describe as the rust of iron combined with water, or watered rust of iron, prepared in the way that is here stated—in such quantities and in such a vessel, and in such a condition as to allow the gas, in the process of manufacture, to pass through it. That, in truth, is the invention of which the plaintiff is, and claims to be, the author. Then he goes on to describe his patent thus:—"This material is to be put into a purifier (such a one as is used for dry lime answers the purpose), and the gas is to be passed through it, whereby the gas will be deprived of its sulphuretted hydrogen, cyanogen, and a part of its ammonia, which will be absorbed into the porous material, water being at the same time formed by the union of the oxygen of the oxide and the hydrogen of the sulphuretted hydrogen absorbed, as soon as the material ceases to purify the gas from sulphuretted hydrogen." Of course as the gas passes through it in its impure state, the sulphuretted hydrogen contained in it is absorbed by this hydrated oxide of iron; but by-and-bye, in process of time, it becomes, as it were, saturated with the impure substances, and then its power any longer to absorb it, until it is renewed by an influx of atmospheric air, ceases. "As soon as the iron is re-oxidized, which generally will be the case in a few hours, the gas is to be passed through it again, when the same effect will take place as at first; and this process of purification and reoxidation or renovation of the purifying material is to be repeated until the purifying material ceases to be efficacious. It is then to be taken out of the purifier, and the sulphur and the cyanogen, and also the ammonia or ammoniacal compounds, may be extracted from it. I prefer to effect the renovation of the purifying material, without withdrawing it from the purifier, by exposing it to the influence of the atmosphere, which may be either admitted to it or be drawn or forced through it by any suitable means, whereby the iron will become re-oxidized and fit for again purifying the gas. Before submitting the gas to the action of the purifying materials before mentioned, I prefer first to take away the greater part of the ammonia by means of a water scrubber, or by any other plan that may be preferred, and then to pass the gas through the porous purifying material before mentioned to remove the sulphuretted hydrogen and cyanogen. The purifying material will then last longer, as the ammonia takes away in combination with it a good deal of the sulphur which would otherwise combine with the iron. The hydrated or precipitated oxides of manganese and zinc may be used in the same manner as described for the oxides of iron, though not with equal advantage. Hydrated or precipitated oxides of iron may be conveniently prepared for these purposes by decomposing sulphate or muriate of iron with hydrosulphuret of ammonia, or with lime, magnesia, potash, or soda; they may then be absorbed into or mixed with sawdust, peat charcoal, or breeze, or other such material, and afterwards exposed to the air." This, therefore, makes the hydrate or peroxide of iron by which this purification is effected. The patent was only taken out, I believe, in the month of November, 1849, and the specification was filed on the 1st of May in the following year, 1850. The immense value of this invention very soon became apparent, and I believe I may say that it is now adopted by all the great gas manufacturers in London, and perhaps elsewhere. And certainly, if ever a man was entitled in all justice and equity to the profits of an invention of which he is the author, it is the plaintiff, Mr. Hills. He finds, however, he has to deal with powerful gas companies; amongst others, the present defendants, who for several years respected his patent, and used the substance which he has discovered in their manufactories, under his license; but in consequence of some circumstances they have thought fit, after having acted under a license, and given to the plaintiff honourably and fairly the full benefit of his invention, to repudiate and disclaim it, and from, I think, the month of December last, have resorted to this process and used this substance, invented by the plaintiff, without his authority and in defiance of his patent. Hence comes the question whether this is a new as well as a useful invention. If you find that it is, of which I fancy there can be no doubt, and that the defendants have infringed the plaintiff's patent, and have used it, then the plaintiff, Mr. Hills, will be entitled to your verdict. Now, gentlemen, as in all patent cases, so in this, we are met by way of defence with a long succession of earlier patents and specifications; and I suppose there is not a single patent that has ever been granted from the beginning of time, in which anything in the nature of a metallic oxide is to be found, which is not brought forward now as identical, suggested as a defence to this action, and claimed to be the invention of which Mr. Hills says he was the author in the year 1849. With regard to these many earlier patents, of which we know something, because there has been a trial already in the Court of Exchequer in relation to this patent, I will say a few words before I sit down. We know pretty well what are the earlier patents and specifications which it will be said deprive the plaintiff of the character of the first inventor of this substance which I have described to you.

Lord CAMPBELL: When was the trial in the Exchequer?

The ATTORNEY-GENERAL: December, 1856. With the exception of one of these patents—a patent obtained by a gentleman of the name of Laming—I shall not trouble you with a single observation upon them. I think it will be for my learned friend either to reject them altogether, or to bring forward such of them as he may think advantageous to his clients' case. If he shall bring forward one or more of them, I shall be prepared to deal with them as they are submitted to my lord and to you, but I will not trouble you with a single observation upon any one of them. I think I shall be able completely to dispose of them, and set them aside as quite immaterial to the present action. I refer only to one patent, obtained by a person of the name of Laming, because that was the principal subject of certain proceedings, and made matter of defence in the Court of Exchequer. It has been, therefore, to a certain extent under judicial consideration, and to that I will for a few minutes beg to direct your attention. In an action brought in the Exchequer, Laming's invention was brought forward by way of defence; and, coupling the specification of Laming with certain evidence which was given in the Court of Exchequer, the Lord Chief Baron, who tried the case, thought that with respect to one part of this invention a defence was established, that its novelty was disproved, and he non-suited the plaintiff. Upon the motion, however, before the Court of Exchequer, when the whole of both patents and specifications—indeed, the whole subject—was brought to the attention of that court, the court was pleased to order a new trial, and that new trial has not yet taken place.

Lord CAMPBELL: You had much better, I think, have deferred the trial of this till that case was disposed of. If I had known that which you have now stated, I would not have allowed you to open the case, because it is clearly for the advantage of all parties that the first cause should be disposed of by that most learned judge, the Lord Chief Baron, before whom it was originally brought. I feel very strongly that it is for the advantage of both sides that that should be the case.

The ATTORNEY-GENERAL: There are some personal considerations with regard to the parties to the other action which render it expedient to try this action.

Lord CAMPBELL: With regard to patent cases, I would not myself try a second action upon a patent the validity of which is *sub judice* in a court of co-ordinate jurisdiction. I think it is not a right thing to be done.

Mr. BOVILL: We actually took that case down by proviso, and they stopped us.

Lord CAMPBELL: As soon as it is disposed of the party has a right to bring another action, but while it is pending I do not think it is a right thing to be done.

The ATTORNEY-GENERAL: My lord, they are different parties altogether in the other action.

Lord CAMPBELL: I fully understand that. No one can be more sensible of the inconvenience to arise from it than the Attorney-General. There are two courts of co-ordinate jurisdiction, and questions of law may arise before each, and they may come to a contrary conclusion. Let it be tried before the Court of Exchequer, and then you may go before the Court of Exchequer Chamber, and by that we must all be governed.

The ATTORNEY-GENERAL: No doubt, my lord. The difficulty is this,—we have to fight against those who have acted under our license. We are in a situation to prove that from last December they have set us at defiance, and have gone on with the manufacture of gas till the present moment.

Lord CAMPBELL: I suppose you can make them keep an account, or something of that kind. It really is highly inexpedient in cases to have double litigation and double expense. I have the power to adjourn the trial

The ATTORNEY-GENERAL: In deference to your lordship's suggestion, I think great evil will result; but, nevertheless, we shall be content to agree to that if we can have a trial speedily. If we could have one in Surrey I should be content.

Mr. BOVILL: I think that the Lord Chief Baron having heard the other case is rather the better judge to try this.

Lord CAMPBELL: If I had tried the case once I should rather dislike to try it again.

The ATTORNEY-GENERAL: I should be glad to do anything to enable us to try the other cause. An account ought to be kept to prevent us going into Chancery.

Lord CAMPBELL: Mr. Bovill, I think you would do well to make arrangements to try it at the Surrey Assizes.

Mr. BOVILL: I was going to mention that the rule for a new trial was made in April, 1857, and the costs were to abide the result. There were six other actions brought against different gas companies, and they let a whole year pass by, and do not begin their action till 1858. I am told by my clients that they would rather have the case tried in London.

The ATTORNEY-GENERAL: That throws it over till November.

Lord CAMPBELL: It is sure to be tried after Michaelmas Term. If it was tried now you could only move in the Court of Queen's Bench either upon a special case or upon questions reserved, and that could not come on to be argued before the month of February, 1859.

The ATTORNEY-GENERAL: Now the case is before your lordship and quite ready for trial, I would rather, if that would satisfy my learned friend, discontinue the other action. I would rather do anything than have it postponed until the sittings after Michaelmas Term.

Lord CAMPBELL: The Court of Exchequer is seized of it and have considered it, and I should think it highly desirable that their opinion should be taken on it.

The ATTORNEY-GENERAL: I have not the least objection to take the opinion of the Court of Exchequer. I was not engaged in that, but we ought not to be exposed to the hardship of postponing this till after Michaelmas Term; but short of that I will do anything my friend will suggest, or of which your lordship will approve.

Mr. BOVILL: They have not been in any hurry to go on with this in any shape or way.

Lord CAMPBELL: I should have thought it desirable that it should be tried at the Surrey Assizes. That would be a very expedient arrangement for both sides.

The ATTORNEY-GENERAL: I must submit to anything that your lordship may think fit to direct.

Lord CAMPBELL: I feel that it would be very desirable. It will be tried before my brother Willes, to whom it is entirely new, he being the senior judge; therefore there can be no preconceived opinion on his part. I should think both sides would be exceedingly pleased to try it before him.

Mr. BOVILL: The difficulty is about the jury. Country gentlemen at Guildford do not know quite as much about gas as a London jury.

Mr. KNOWLES: It may possibly turn out on a calculation that the increased expense of going to Surrey will be so great that we should prefer to take it over to Michaelmas Term; but let us have an opportunity of choosing.

Mr. BOVILL: I cannot have any objection to that if you determine in three days.

Lord CAMPBELL: It ought to be done immediately.

The ATTORNEY-GENERAL: Then we will determine in three days either to try it in Surrey or to try it after the sittings in Michaelmas Term.

Lord CAMPBELL: Then I will adjourn the case.

Miscellaneous News.

BALANCE-SHEET OF THE WORKSOP GAS COMPANY,

FOR THE YEAR ENDING JUNE 1, 1858.

Dr. RECEIPTS.				*Cr.* EXPENDITURE.				
Balance	£ 508	0	5	Paid one year's dividend and interest, due June 1, 1857			£ 487	18 11
To cash received for 1,800,000 feet of gas, at 5s., due Dec. 1, 1857	450	0	0	Ditto interest on loans and advances			207	6 3
Ditto for lights by contract	10	9	6	By cash paid for coal—742 tons	£ 325	14 11		
Amount due for 2,294,700 feet of gas, on June 1, 1858, at 5s.	573	13	6	Ditto for furnace coal—62 tons	29	18 3		
Ditto for lights by contract	9	10	0	Ditto for lime	28	0 7		
Ditto from the Local Board of Health, for lighting the public lamps one year	285	3	2	Ditto for repairs at works and mains	30	16 2		
Ditto for coke sold	284	16	11	Ditto for wages	84	8 6		
Ditto for tar and water sold	52	15	4	Ditto for retorts and setting	25	4 8		
Cash of railway company for rent of meter	2	0	0	Ditto for rates and taxes	81	11 8		
				Ditto for new services	18	4 8		
				Ditto for cost of public lamps	57	3 6		
				Ditto for leading coke	14	6 1		
				Ditto for salaries	75	2 4		
				Ditto for printing and stationery	14	3 6		
				Ditto to directors	5	0 0		
				Ditto for arrears	1	13 4		
				Ditto for sundry payments	7	1 0		
							798	9 2
				Balance available for dividend			682	14 6
	£2,176	8	10				£2,176	8 10

CAPITAL ACCOUNT.

Dr.				*Cr.*			
1849. Cash received for 500 shares, £10 each	£5,000	0	0	1849. Purchase of works	£5,000	0	0
1851. Ditto for 55 shares, £10 each	550	0	0	1851. Erection of small gasholder and tank	550	0	0
1853. Ditto for 45 shares, £10 each	450	0	0	1853. Extension of mains	450	0	0
1855. Ditto on mortgage	4,000	0	0	1854. Law charges and other expenses for obtaining the company's Act of Parliament	1,098	2	6
1857. Ditto for 550 new £5 shares	2,750	0	0	To cost of land to erect new gasholder	397	5	0
1858. Ditto for 50 new £5 shares	250	0	0	1858. Ditto of new retort-bench, retort-house, purifiers, scrubber, condenser, connexions, and iron roof to retort-house	1,057	3	7
Balance	177	5	9	Ditto for building retort, purifier, and meter-house, and coal and coke sheds	811	4	9
				Ditto of iron tank and gasholder	2,053	6	0
				Ditto of station-meter for works	46	19	9
				Ditto of test-meter, governor, and photometer	43	1	0
				Ditto of new mains and extensions	1,245	1	0
				Ditto of tar tank, fixing, and carriage	28	11	2
				Ditto of filling up and securing old tank	12	16	3
				Ditto of fencing and doors for new yard	53	5	5
				Engineer's charges	134	10	2
				Paid for sundry labour	8	10	7
				Ditto for sundry leading	13	3	3
				Ditto for printing	7	7	4
				Ditto for sundry payments	45	6	10
				Ditto for interest	66	8	1
				Eddison and Clough, attorney's bill	55	3	1
	£13,177	5	9		£13,177	5	9

Gas manufactured in the year ending June 1, 1858	5,816,700 cubic feet.	
Ditto ditto June 1, 1857	4,835,000 do.	
Increase on the year	971,700 cubic feet.	
Quantity of gas made at the works during the year ended June 1, 1858		5,816,700 cubic feet.
Of the above has been consumed by meter	4,094,700 cubic feet, or 70·4 per cent.	
By public lamps	970,100 do. or 16·7 do.	Of the quantity made.
By contract burners, works, &c.	200,000 do. or 3·4 do.	Of the quantity made.
Loss by leakage	551,900 do. or 9·5 do.	Of the quantity made.
	5,816,700 cubic feet.	

EXPLOSION OF A GASHOLDER AT THE CARDIFF GAS-WORKS.

The premises of the Cardiff Gas Company are situated in Bute Terrace, and are very extensive, there being a large area to supply with gas. Recently the large gasometer on the righ-hand side of the premises, and nearest St. Mary's national schools, has been undergoing repair, the nature of the repairs being to add strength to the gasometer by internal appliances. It is a large one, being 112 feet in diameter and 28 feet in depth. The works were finished last week, and the gentleman who had been effecting the repairs, previous to going away, wished to see whether the gasholder was fairly balanced or not. For that purpose some air was introduced, the effect of which was to raise the gasometer, but it did not raise it sufficiently high, and then a quantity of gas was allowed to go in. This was on the 3rd inst.

The operators at the works had to prepare for lighting the town that night, and in endeavouring to withdraw the gas from the gasometer so as to distribute it through the town, the air which had been put in became mixed with the gas, which was the cause of the defect in the lighting of the town on that night. The gasometer continued in the same state throughout this week, having in it a mixture of air and gas, and such was its condition when the explosion occurred. We understand that when air is once introduced into a gasometer, it is a most difficult matter to withdraw it. For the purpose of withdrawing it the following appliances were fixed:—On one side are two large pipes, one of which admits the gas from the retorts to the gasometer, and the other transmits it from the gasometer into the town. Into each of these pipes a half-inch pipe was inserted for the purpose of allowing the air that was in the gasometer to escape—they were, in fact, a kind of escape-pipes, which would have the effect, in time, of drawing off that element which was inimical to the proper operation of storing and distributing the gas for the use of the town. Parallel with the position of the large pipes just referred to are some of the buildings where the operations of gas-making are carried on, and between the ends of the small waste-pipes and the buildings in question there was a distance of seven yards.

About one o'clock in the afternoon of Friday, the 9th inst., the foreman of the works, in the absence of Mr. Bowen, the manager, proceeded with a lighted candle in a lantern to try the lights in the workshops. As he was proceeding on this errand the explosion occurred, the effect of which was to blow off the whole of the top of the gasometer, and also to break some of the iron girders of the external framing. The concussion was most alarming. It was heard in all parts of the town, and caused great alarm and anxiety. Hundreds of persons rushed to the spot at once, and observing the destruction of the gasometer, which was rolled up as though made of canvass, the exaggerated notion was speedily propagated that both bodily injury and loss of life was the result; but happily all escaped, with the exception of the foreman himself, who was slightly burned.

The offices occupied by Mr. Bowen, and the show-rooms, were however considerably injured, the windows being blown in and the doors and locks destroyed. One window in front of the building was also broken, but the principal destruction was at the back, and, consequently, unseen from the street. The residence of the foreman was also damaged to a considerable extent. The adjoining school-rooms and other neighbouring property was to some extent shattered, but not very greatly. One circumstance, no doubt, contributed to lessen the mischief that was done. Only a small portion of gas was in the gasometer, and it had only risen about three feet from the tank. There was, therefore, the less explosive power within it.

In the course of the afternoon a searching inquiry was made into the cause of the occurrence, C. C. Williams, Esq., chairman of the directors, and other gentlemen of the executive, together with Mr. Bowen, directing all their energies to ascertain what had led to the accident. The foreman was called upon to account for his conduct, and he said he was trying the gas by the lights in the workshops, but did not go nearer the waste-pipes than seven yards. How that may be we cannot decide, but it seems very unlikely that the waste which was coming through those pipes should have ignited at that distance; and therefore the more probable solution of the difficulty is that the foreman, in an unthinking moment, applied his candle to the end of one of the pipes, and thereby the dreadful result followed. We cannot for a moment suppose, if the above solution is the true one, that the foreman did that in any other than an unreflecting manner. And we cannot but remark how vastly important it is that persons who are dealing with such subtle agencies as explosive gases should be thoroughly aware of the consequence of all they do. It may be that the unusual occurrence of the introduction of the waste-pipes was a proceeding that did not suggest any of those probabilities which belonged to it, and therefore it did not suggest to the foreman's less scientific mind that the application of a lighted candle was pregnant with such a dire result. Thus the question stands at present, we believe; and it is worth observing, as illustrating the controlling knowledge possessed by those who have the management of gas-works, that only four explosions from the introduction of foul air are known to have occurred in this country.—*Abridged from the Cardiff Times.*

EMBEZZLEMENT FROM THE LEEDS NEW GAS COMPANY.—At the Leeds Borough Sessions, Joseph Silversides Bell was indicted for having feloniously embezzled certain moneys, the property of the New Gas Company, at Leeds, on the 11th of March, 1858. The prisoner pleaded guilty. Mr. Blanshard, who conducted the prosecution, stated that the prisoner was employed by the company to collect money, and had to account daily to Mr. Hall, one of the managers. It was discovered, however, that he had embezzled a sum of £9. 19s. 9d., another sum of £3. 2s. 9d., and a third sum of £3. 15s. 4d. The prisoner had been about five years in the service of the company, and had, up to the discovery of the embezzlements, enjoyed a good character. The prosecutor did not feel in a position to recommend to mercy, as he was acting vicariously for the company, but had the case been merely a personal one he should have done so. The prosecutors did not desire to press the case. Mr. Wheelhouse, the prisoner's counsel, offered a few observations, remarking upon the good character which Bell had previously had, and also upon the fact that he had a wife and five or six children. He also said the prisoner's salary was too small The Recorder, in passing sentence, said embezzlement was an offence which he generally punished with great severity, inasmuch as, in almost all cases, the acts of embezzlement charged were only evidence of a long course of fraud. This did not appear to be so in the present case, for the embezzlement of the prisoner seemed to have been almost entirely confined to two or three cases. Taking into consideration the recommendation of the prosecution, which was tantamount to a recommendation of mercy, and also the previous good character of the prisoner, he thought the sentence he ought to pass was one of imprisonment, with hard labour, for six months, during which period the prisoner would be employed at the desk, or in other labour suitable to him.

SERIOUS EXPLOSION OF GAS AT HALIFAX.—On Saturday week, or rather early on Sunday morning, the 11th inst., a serious explosion of gas occurred in the shop of Mr. John Spencer, news-agent, Northgate, Halifax. The shop is the one at the south end of the large pile of buildings recently erected in Northgate, opposite the Northgate Hotel, by Mr. Boddy, grocer, and popularly called Boddy's Buildings. All of them are large, roomy, handsome places, fitted throughout with plate-glass windows of considerable size. Mr. Spencer had removed from the opposite side of the road within the last week, intending to occupy the front part of the premises he rented as a shop for the sale of newspapers, second-hand books, &c., and the house part as a temperance hotel. The particulars of the accident are as follows:—The premises were closed at midnight, and in about half an hour the inmates went up stairs, intending to retire to their respective dormitories for the night. On the second story, however, a strong smell of gas was perceived, and Mr. Spencer set about forthwith to find out the place of escape. For that purpose he entered the large room over the shop with a lighted candle, and in an instant a frightful explosion took place. Mr. Spencer was dashed to the ground with great violence, and his face, hands, and arms were badly burnt; but his wife and sister, who were standing on the landing, happily escaped uninjured. The south wall of the building was damaged, and several plate-glass windows in the large room, the passage, and other rooms on the same story were smashed to atoms, while the woodwork was very much scorched by the fire. Indeed, so great was the force of the explosion, that pieces of glass were forced into the shutters of the shops on the opposite side of the street; and had it happened an hour and a half earlier, when large numbers of people were returning from the market, the consequences would no doubt have been most lamentable. The escape of gas was accounted for afterwards, when it was discovered that in the ceiling of the room where the explosion took place, preparation had been made for the suspension of a chandelier, and the plug temporarily put in the gas-pipe had dropped out.

FIRE AT THE GAS-WORKS, SUSSEX STREET, SHEFFIELD.—On Saturday, the 19th inst., a very alarming fire took place at these works in consequence of the leaking of a tar still, which has been lately erected in the vicinity of two new large telescopic gasholders. The naphtha vapour exploded and lifted the still, and breaking off the letting-out pipes, the contents, some 2000 gallons of hot tar, escaped and took fire, the conflagration spreading and destroying the building and apparatus. Luckily, a large new gasholder in the immediate vicinity was empty, or the result might have been still more disastrous. The flames from the boiling tar rose to the height of 20 yards, and partly surrounded it, scorching the top, and heating the pillars to a considerable degree. The town engines were soon on the spot, and saved from destruction an adjoining building in which were several hundred gallons of rectified naphtha and other inflammable materials.

Price Current.

CASTINGS, per Ton.

Average Weight of Cast-Iron Gas-Pipes, per Yard.

1¼ in.	2 in.	2½ in.	3 in.	4 in.	5 in.	6 in.	7 in.	8 in.	9 in.	10 in.	12 in.
16	21	28	33	51	70	89	107	126	149	177	208 lbs.

Retail Prices are 5 to 10 per cent. higher.	London.	Glasgow	Newcastle.	Wales.	Yorkshire Derbyshire and Staffordshire.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Pig Iron, No. 1	4 10 0	2 14 0	3 0 0	4 0 0	4 5 0
1¼ and 2 inches Socket Pipes	7 15 0	7 0 0	7 5 0	7 10 0	7 5 0
2½ and 3 " " "	7 5 0	6 15 0	7 0 0	7 5 0	7 0 0
4 and 5 " " "	7 5 0	6 10 0	6 15 0	7 0 0	6 15 0
6 in. & upwards " "	7 0 0	6 5 0	6 5 0	6 15 0	6 5 0
Retorts, 1st fusion, hot blast	6 15 0	...	6 15 0	7 0 0	6 15 0
" 2nd " cold "	7 15 0	...	7 0 0	7 5 0	7 0 0
Tank Plates, ⅜ thick and above	7 5 0	6 10 0	6 15 0	7 0 0	6 15 0

COALS.

NEWCASTLE. Unscreened.	s.	d.		SCOTCH CANNEL.	per ton.
Whitwell Primrose	6	3	per ton	Boghead, at Leith	32s. 0d.
Medomsley, Eighton Moor, and Burnhope	6	6	"	Kirkness, best	23 0
Pelaw	6	9	"	Capeldrae, 1st quality	20 0
New Pelton, Peareth, South Pelaw, Washington Hutton, and South Peareth.	7	0	"	" 2nd "	12 6
Pelton	7	9	"	Lesmahago, at Glasgow	25 0
Ramsay's Newcastle Cannel	16	0	"	" " Leith	27 6
				Arniston	22 0
				Wemyss	20 0
				Knightswood	18 0
				Pirnie	15 0

SUNDRIES.

Best Newcastle fire-bricks	60s. per 1000	English pig lead	£21. 10s. per ton.
" " clay	12s. per ton.	Welch bar iron, in London	£7. 5s. "
Cliff's fire-bricks at Wortley	57s. 6d. p. 1000	Foreign spelter	£24 "
Ingham's fire-bricks at Wortley	55s. p. 1000	English block tin	£118 "
Tough cake copper	£107 per ton.	Banca "	£119 "
Tarred rope yarn	26s. per cwt.		

WROUGHT-IRON TUBING, subject to 40 per cent. Discount.

	2 inches.	1½ inch.	1¼ inch.	1 inch.	¾ inch.	½ inch.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
Patent welded tubes, from 2 to 12 feet, per foot	1 8	1 0	0 10	0 7	0 5	0 4½
" " " 6 in. to 18 in., each	3 0	2 0	1 9	1 3	1 0	0 9
Connecting pieces, or long screws	3 6	2 3	2 0	1 6	1 2	0 11
Bends, springs, and elbows—wrought iron	3 9	2 3	1 9	1 0	0 10	0 8
Tees, wrought or cast	4 0	2 6	2 0	1 6	1 1	0 10
Crosses, wrought or cast	4 6	3 0	2 6	2 0	1 6	1 2
Iron cocks	17 6	9 6	7 6	4 6	3 3	2 6
" with brass plug	28 0	16 0	13 0	7 0	5 6	4 6
Diminishing sockets, caps, plugs, and nipples	1 3	0 9	0 8	0 6	0 5	0 4
Plain Sockets	1 0	0 8	0 7	0 5	0 4	0 3
Syphons, 2 quart	15 0	14 0	13 6	13 0	12 0	

FREIGHTS.

Coastwise—Newcastle.	Per Ton.	*Foreign.*	Per Keel.
Chatham & Roches- [ter	5s. 3d	Boulogne & Calais	£ 7 0s
Cork	7 6	Barcelona	22 10
Dover	5 9	Bordeaux	13 0
Dublin	8 3	Cadiz	£13. 15s. to 14 0
Exeter Quay	7 6	Copenhagen	£8 to 8 10
Folkestone 5s. 6d. to	5 9	Dieppe	7 10
Hastings	—	Genoa	21 0
London 5s. 3d. to	5 6	Hamburg	7 7 6
Lowestoft & Yar-	4 1¼	Havre	8 5
Lynn [mouth	4 6	Leghorn	20 0
Portsmouth	6 6	Lisbon	16 0
Plymouth	6 9	Rotterdam	7 0
Whitstable	5 6	Stettin	£10 to 10 5
Weymouth	7 0	Trieste & Venice,	£21 to £23

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WORTLEY FIRE-BRICK AND RETORT WORKS,

Near

Leeds.

W. INGHAM and SONS, having for many years been extensively engaged in the Manufacture of
RETORTS AND FIRE-BRICKS FROM THE CELEBRATED WORTLEY FIRE-CLAY,
beg to call especial attention to their RETORTS, which have for many seasons proved to be unsurpassed in quality by any in the Kingdom, their FREEDOM FROM CRACKS and the ADHESION OF CARBON rendering them worthy the attention of all parties interested in the making of Gas.
The Works are of such magnitude as to ensure the prompt execution of orders to any extent.

Estimates for Setting, or Bricklayers sent when required.
GAS OVENS IN SEGMENTS OF EQUAL QUALITY.
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N.B.—*Export orders continue to have prompt attention.*

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ESTABLISHED IN 1795.

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FIRE-BRICKS, LUMPS, GUARDS, TILES, AND CLAY OF THE SAME QUALITY.
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ORLANDO BROTHERS,
MANUFACTURER OF PATENT CLAY RETORTS,
AND EVERY DESCRIPTION OF
TUBULAR GLAZED SEWERAGE PIPES, BENDS, JUNCTIONS, ETC.
FIRE-BRICKS, TILES, BLOCKS, AND CHIMNEY-TOPS.

TO GAS COMPANIES, GAS PROPRIETORS, AND GAS ENGINEERS.
JOHN VICKARY

begs to call the attention of the above to his improved METALLIC CASE GAS-METER, an improvement which has met with entire approbation from the various Gas Companies and Engineers to whom he has introduced it, and acknowledged to be the greatest improvement that has been made since the year 1832; at which period a metal was introduced for the construction of the Drum, Syphon, and Float, capable of resisting any impurities arising from either gas or water, which has been found to answer every expectation; as, in repair, Drums of the above date are found in perfect and good condition, when the Outer Case, Valve-box, Inlet-pipe, &c., are quite destroyed and entirely past repair.
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J. V. feels confident that the above will be found a most desirable and perfect instrument, as it contains all other improvements of utility that have been introduced up to the present time.
The most strict attention is given to the workmanship as well as the registration of every Meter, to render them perfectly accurate.
Station Meters, Governors, &c., made on the shortest notice, as well as Gas Cooking Apparatus of every description, Gas Baths, &c.
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Carriage paid to any part of England.

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FIRE BRICKS OF EVERY DESCRIPTION, SHAPE, AND SIZE, &c. &c.
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These RETORTS are generally used in the Gas-works of Preston, Accrington, Bury, Heywood, Middleton, Rochdale, Ratcliffe; the Mills of Messrs. Horrocks, Miller, and Co., Preston, &c. &c., and are unequalled in having afforded general satisfaction to those who have given these Retorts a trial.
To meet the increasing demand, the Works at Little Harwood have been greatly enlarged; and Gas Engineers who may favour with an Order may rely with confidence on their being promptly supplied with an article not to be surpassed in finish or durability.

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DIRECT-ACTING GAS-EXHAUSTERS,
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FOUR-WAY DIAPHRAGM VALVES,
one of which answers the purpose of THREE ordinary Valves, as applied to Purifiers, or in shutting off and passing Station-Meters, Governors, or other apparatus, while the Connecting-Pipes are also much simplified.

RETORT SETTINGS,
designed to be heated by Tar alone, and with a total absence of Smoke.

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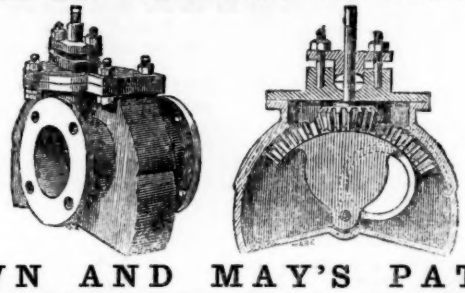

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No. 1—1 ft. 6 in. wide, any length.
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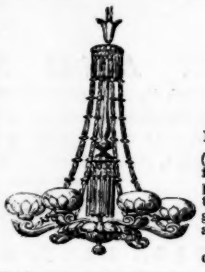
AND
WENLOCK IRON WHARF, 20. WHARF ROAD, CITY ROAD, LONDON,
Beg to inform Gas and Water Companies and the public, that they keep in stock in London all the CASTINGS in general use in Gas and Water Works, including best cold-blast Iron Retorts, Socket and Flange Pipes of all sizes, Bends, Branches, Syphons, Lamp Columns of various patterns, &c.
N.B.—Orders for Cast-iron Tanks, Girders, Columns, Cylinders, and all irregular castings, will have immediate attention.
CHARLES HORSLEY, Agent.
C. H. is prepared to carry out the warming and ventilation of public buildings, &c.; also civil engineering in general.



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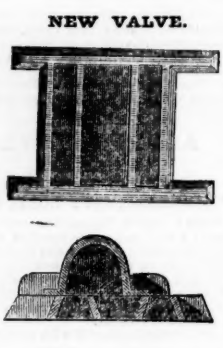
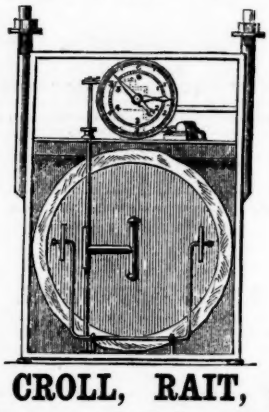
44, OXFORD STREET, LONDON;
Manufactory—Broad Street, Birmingham—Established 1807,
MANUFACTURERS OF GLASS CHANDELIERS, GLASS LUSTRES, TABLE GLASS, &c. &c.
ELEGANT CRYSTAL GLASS CHANDELIERS, for GAS, from £4 upwards
(Made from "REGISTERED" DESIGNS), with GLASS BRANCHES, &c.; suitable for DRAWING-ROOMS and BALL-ROOMS. The more extensive use of GAS in private dwellings has induced Messrs. OSLER to direct their particular attention to the manufacture of this class of articles—which, with a view to their general adoption, are offered at very moderate prices. Purchasers can select from a great variety of patterns, to which additions are being constantly made.
THEATRES, CONCERT, ASSEMBLY, AND BALL ROOMS LIGHTED BY ESTIMATE ON THE LOWEST TERMS.

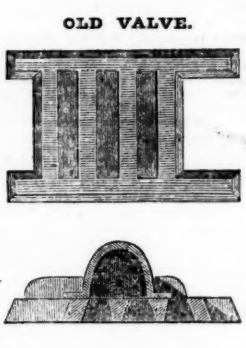
CROLL'S
PATENT IMPROVED DRY GAS-METER,

NEW VALVE.





OLD VALVE.



Manufactured by CROLL, RAIT, and CO., LONDON.
FACTORY—Blundell Street, near the Railway Station, Caledonian Road, N.
OFFICES—10, Coleman Street, City, E.C

Messrs. CROLL, RAIT, and Co. beg to call the attention of Gas Companies to their Improvements in Dry Gas-Meters, which secure a steady light under all circumstances.

In forming the Valve-Seat of the Dry Gas-Meter it has hitherto been usual for the Bars to be equal in width to the openings; but, by the extent of the surfaces thus brought into contact with the Valve or Cover, it is found that fluid accumulates, and, during part of the motion of the Valve, partially closes the passage, thereby causing an oscillation in the lights.

An Improvement in the Manufacture now introduced and patented by Mr. CROLL consists of very considerably reducing the width of the Surfaces or Bars, as in the drawing of the New Valve, retaining only such width of bar as is necessary to secure correct measurement.

Another Improvement consists in the mode used of mixing and amalgamating the various proportions of Metals for the Valve, always taking care that the Valve-Seat shall be of an alloy considerably different to that of the Valve-Cover, by which the friction of the surfaces is materially lessened.

These Improvements remove at onee any liability to unsteadiness of light, and at the same time secure (from the Valve working more evenly) a greater certainty of accurate registration.

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PATENTEES and MANUFACTURERS of the ONLY GOOD MERCURIAL GAS REGULATOR,
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